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You Might Imagine

From an inspection of the Table of Contents for this issue that there could be nothing on hand equally good for August.

You Would be Mistaken

in entertaining such a notion. For instance, at the present time we can tell you that there will be

Another Paper on Concrete Road Construction. This road was built at the San Francisco Presidio by the U. S. War Department to replace water bound macadam. A unique method of providing for contraction was used in which you will be interested.

The Cement Gun is Receiving Increased Attention, and the fact that the city of San Francisco specified a Gunite finish on the reinforced concrete trolley poles for the municipal street railway indicates a thorough appreciation of this method of cement finishing. John S. Martin, who did the work, will tell all about it in the August issue.

Those Interested in Hydraulic Pipe Line Phenomena will receive a new impression of inertia effects when they read S. L. Berry's conclusions. Incidentally, a mass of water enclosed within a pipe line under static pressure does not move forward as a solid unit when the valve is opened. The formula ordinarily used, according to Mr. Berry, is incorrect.

Graphic Representation of Topography in geological mapping has an interesting application in studying petroleum and gas pools. L. G. Huntley shows how this method is beneficial to oil producers.

The Panama Canal is Primarily a Waterway, but its construction has also made possible an interesting development of hydro-electric power. The reservoir made by the Gatun dam is to be utilized as a source for the development of 7500 K. V. A. through Pelton Francis turbines and General Electric alternators. All the power for operating the canal locks and towing locomotives aided by an emergency steam plant, will come from this source. This hydro-electric development will be fully described and illustrated in the next issue.

NOR IS THIS ALL

Other articles of special interest to contractors will be a feature of this, as well as successive issues.

You Will Want the August Issue

the September issue, and all the rest of them too.

THE IMPROVED METHOD of preparing the **TABLE OF CONTENTS** enables the title and summary of each article to be clipped and pasted on 3 by 5 cards for indexing.

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EDITORIAL

FINANCIERS interested in the New York, New Haven & Hartford railroad are cutting a Mellen.

MORE than two thousand applications have been received by the city engineer of San Francisco for employment on the engineering staff for the Hetch-Hetchy municipal water supply project.

INDEX for the fourth volume of *Western Engineering* is now ready for distribution and will be mailed to all those who desire to have their back numbers bound. Drop a line to the circulation manager and the index will be sent by return mail.

THE bill repealing the exemption of American coastwise vessels from the payment of tolls through the Panama canal was signed by President Wilson on June 15, thereby settling the vexed question as to the interpretation of the provisions of the Hay-Pauncefote treaty.

ACCORDING to a contemporary, an editor who started about twenty-five years ago is now worth $100,000. At first this seems somewhat startling, but the explanation is offered that his accumulation is due to frugality, good habits, strict attention to business and incidentally to the fact that an uncle died and left him $99,999.

MOUNT LASSEN, acting under a franchise granted some years ago by Dame Nature, has resumed active business as a volcano without having received a certificate of public convenience and necessity from the California Railroad Commission. An injunction is now in order, for ignorance of the existence of the public utilities act is neither an excuse nor an extenuating circumstance for its violation.

WORD has been received that Mr. F. M. Smith has disposed of his borax holdings by sale to an English company for $4,000,000, thereby providing himself with funds for the payment of some of his debts. It is said that when all of Mr. Smith's obligations will have been met there will remain but $5,000,000 of his original fortune. Most of us, however, would be willing to accept poverty on this basis.

THE Valley Pipe-Line Company, a subsidiary of the Royal Dutch-Shell interests, has commenced the work of installing its new oil pipe-line. An order has been placed with the Youngstown Sheet & Tube Company for 131 miles of 8-inch and 41 miles of 10-inch pipe. This covers that portion of the proposed line extending from Coalinga to Martinez. The estimated cost for the entire installation, including pumping stations and other equipment, is about $22,500 per mile, which gives an estimated total cost for the entire installation of approximately $3,800,000. Sanderson & Porter are consulting engineers for the Company and will supervise the entire installation.

PROSPECTING for oil near Calgary, British Columbia, has resulted in the discovery of a fine quality of oil at a depth of 2700 feet in what is called the Dingman well. According to Mr. Samuel C. Reat, United States consul at Calgary, the oil is of 64° Baumé gravity and can be used successfully in automobiles after being cleansed in a filter. The output of the well is given at 900 gallons in six hours. The stock boomer is as usual the first man on the job. The Calgary newspapers as well as others in the Pacific northwest are bristling with the usual 'get-rich-quick' advertisements. Times are hard and money is scarce, especially for legitimate investments, but the human propensity to gamble on the 'sure things' offered by the stock brokers will probably result in the usual redistribution of a considerable sum of money and add to the experience of the unskilled investor, as has been done many times before.

WORD has been received from Fresno of the first arrest for inflicting willful damage upon the new state highway. A farmer drove a combined harvester along the state highway south to Herndon in defiance of a request from the division engineer to drive along the side of the highway and off the pavement. As was to have been expected, the large cleats of the wide faced wheels of the harvester inflicted considerable damage upon the pavement. It is difficult to understand the spirit that actuates any man to willfully ruin roads in this way. Harvesters, well drilling, and other heavy traction rigs with cleated or heavily studded tires have been driven on sections of the state highway in Madera and Santa Clara counties. An instance is known where a disc harrow was driven over the state highway near Los Angeles. It is to be hoped that an example will be made of offenders that will be sufficiently severe to deter any others who may be inclined to do likewise.

THE Midway Gas Company is not disposed to submit tamely to the low rates arbitrarily established for natural gas by the Los Angeles city council. The Company has filed a voluminous bill in equity in the

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United States District Court in which it is declared that the gas rate fixed by the city of Los Angeles is unreasonable, unfair, and confiscatory, and an injunction is asked to restrain the city authorities from enforcing the ordinance; and also that the ordinance be declared null and void. The grounds for these requests are that the ordinance violates the fourteenth amendment to the Constitution in that it deprives the Company of its property without due process of law and also that it is discriminatory, because the Southern California Edison Company, which supplies only ½ of 1 per cent of the total amount consumed for domestic purposes, is favored. As we pointed out last month, it hardly seems reasonable to establish half rates for natural gas of nearly twice the calorific value of the manufactured product.

BECAUSE the Great Western Power Company and the Pacific Gas & Electric Company through some chance, psychological or otherwise, bid the same amount for supplying electricity to the state buildings in Sacramento, the state authorities have threatened to build steam plants in every one of the twenty-three state institutions now supplied by these companies. This would be a very interesting course to pursue. The manufacturers of steam plant machinery are badly in need of work and twenty-three new plants to be installed in the state of California would be good news indeed. We would be interested in knowing, however, just what sort of a report a first-class engineer would make on the comparative cost of power based upon the usual load factor prevailing in state institutions, comparing a steam plant with electricity as supplied by any of the public service corporations. The total business amounts to $125,000 per year gross, but when divided among twenty-three institutions it does not seem to be such a large item after all. It would take a very good steam plant of say 100 kilowatt capacity with a 20% load factor to generate electric energy at a price that would compare favorably with that of hydro-electric power.

THE voters of the east San Francisco Bay district have expressed their disapproval of the formation of a municipal water district. The result of the vote was undoubtedly due to a complete misunderstanding of the situation. The majority of voters seemed to regard the proposition as a scheme whereby the people would be compelled to purchase the property of the Peoples' Water Company, while as a matter of fact the object in calling for a vote was to authorize the east bay cities to form a district for developing a municipal water supply. Mr. Frank C. Havens offered to sell such of the property owned by the Peoples' Water Company as might be deemed necessary for water supply purposes to the east bay cities at a price to be determined by the California Railroad Commission. It is difficult to understand what sort of an offer could be more fair than this. At the same time, recent disclosures concerning the financial condition of the Peoples' Water Company have not tended to produce confidence in the Company, and these disclosures evidently resulted in clouding the issue. The water situation in Oakland will soon become serious, and as it will undoubtedly be a matter of years before the Hetch-Hetchy supply will be available, the failure of the voters to authorize the municipal water district will prove to be a serious barrier to extensions in outlying districts, as the Peoples' Water Company's financial condition is such that no funds are available for improvements or betterments. It is to be hoped that the matter may be reopened at some later date when a better understanding of the situation will prevail.

EXCELLENT progress is being made in the preliminary work for the Knights Landing cut project. This is one of the several reclamation and flood control measures for the upper Sacramento valley. The initial examination was conducted by Messrs. Haviland & Tibbetts, consulting engineers of San Francisco, in behalf of the Knights Landing Ridge Committee, of which Mr. A. G. Folger of Sacramento was chairman, and Stuart S. Hawley of Oakland was secretary. An abstract of some of the features of this report was published in our issue of February, 1913. In general the plan deals with a method for controlling floods in the Colusa and upper Yolo basins. The method recommended by Messrs. Haviland & Tibbetts involves making a cut near Knights Landing by which flood waters may be by-passed; the cut to have a capacity of 20,000 second feet with the water at elevation 39 at Knights Landing. The scheme recommended also provides that rights of way and levees are to be located so as readily to permit of ultimate enlargement to carry 30,000 second feet with the water at elevation 44 at Knights Landing. An estimate has just been completed by a committee composed of Messrs. P. N. Ashley, Yolo county surveyor; P. A. Haviland of Haviland, Dozier & Tibbetts, and C. Hicock of Colusa, showing a cost of $800,000 for cutting the Knights Landing ridge. This committee has been instructed by the Board of Trustees for the district to estimate the apportionment of the cost *pro rata* among the owners of 72,000 acres of land lying in Yolo and Colusa counties, the value of which will be greatly enhanced by the consummation of the project. The next step will take the form of proceedings before the Board of Supervisors of Yolo and Colusa counties at which protestants will have an opportunity to voice any objections that they may have. The assessment is not to be apportioned upon a uniform scale per acre, but is to be based upon the proportionate benefits derived by the land as well as the number of acres involved in each case. The object of doing the work is one of the many constructive measures now being undertaken by organizations of California farmers, and is a healthy indication of the spirit of progress that is fast becoming common to western farming communities.

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REVIEW OF THE MONTH

MIDSUMMER has arrived and no marked change has occurred in the financial situation. The mills of the gods grind slowly indeed, and refinancing is the order of the day. This, without involving the actual transfer of real money, is a problem. It is difficult to convince a holder of one share of stock having a 'par' value of $100 that it is to his advantage to accept in change a certificate equally attractive pictorially but having a 'par' value of only $20. This situation brings out the absurdity of the so-called par value of shares. There may have been a time in some remote age now long forgotten when the par value of stock represented an equal amount of money or its equivalent actually invested in a corporation. The only present reason for adhering to this custom, outside of the fact that it has become a habit, is to give to stock sales the outward appearance of bargains.

"SHARES in the 'X. Y. Z.' Company, par value $1, special price for one week, only 10 cents per share; next week the price will be increased to 15 cents per share; buy now," and so on, *ad infinitum*, *ad absurdum*. A stockholder owns no more than certificates which entitle to him to a relative fraction interest in the assets of a company after all prior obligations have been met. While the par value of a stock may be said to represent the hopes of the promoters, the market price is a fairly true approximation of the actual value.

NATOMAS CONSOLIDATED has come forward with a plan for refinancing. Mr. Frank B. Anderson, who seems very much in demand as a first aid to languishing enterprises, has returned from London, where he went to confer with the London bondholders in an effort to obtain their consent to his plan to place the project on its feet. A new California corporation is to be organized which will take over the properties of the present Company, and continue dredging, reclamation, and irrigation work without interruption. The new Company will have the following capitalization, bond, and note issues:

Five-year notes	$3,000,000
Twenty-year 6% first mortgage bonds, of which $4,500,000 will be used to secure the five-year note issue	16,500,000
Non-cumulative preferred stock, non-assessable	7,250,000
Common stock, non-assessable	9,250,000

The Company reserves the right to pay the first five years' interest on the bonds in fully paid bonds of the same series, and about $2,500,000 of the total bond issue will put aside for this purpose. The common stock is to be taken over by a new English company which is to be formed for the purpose with a capital stock of £600,000. The plan for the issuance of the bonds and shares of both the new California and English companies provides that the Natomas Syndicate will buy for $2,700,000 and a majority of stock of the English company all of the above note issue. Each holder of $1000 first mortgage bonds of the Natomas Consolidated will receive in exchange $600 of the new first mortgage bonds and $400 in preferred stock. Each holder of $1000 second mortgage bonds will receive in exchange $500 in preferred stock and £5 in stock of the English company. The floating indebtedness creditors will surrender such security as they have, and in exchange receive unsecured notes of the new California company or the five-year notes of the new Company at 90 cents.

A REORGANIZATION committee has been formed consisting of Messrs. Herbert Fleishhacker, Percy T. Morgan, Curtis H. Lindley, George E. Webber, and Frank B. Anderson. These gentlemen, together with Messrs. John D. McKee, F. W. Kiesel, H. C. Hoover, Louis Sloss, and W. Mayo Newhall will constitute the board of directors for the new Natomas company.

FURTHER details have also been given by Mr. Anderson concerning the affairs of Mr. F. M. (Borax) Smith. A contract has been signed in London providing for the sale of 350,000 shares of Borax Consolidated, Limited, at 34 shillings per share, together with an option on 100,000 shares more for sixty days at the same price. When this transaction is completed there will be available about $3,500,000 for the payment of creditors of Mr. Smith and the Realty Syndicate, if they hold stock in any of the borax companies as security. Apparently there is a good prospect that considerable sums in real money will make their appearance in San Francisco within a short time, which should help materially to clarify the financial atmosphere.

THE tipping evil was the chief point at issue at the hearings recently conducted before the California Railroad Commission in the case of Pullman sleeping car rates. An imposing array of dignitaries representing the Pullman Company journeyed to California in their private car in order properly to present their side of the case before the Commission. It was pointed out that uniformity of service to patrons under the method of compensation for employees now in vogue was impossible, and if tipping were abolished and a living rate of wage paid, better conditions from the standpoint of the patrons would obtain. There is no

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denying that tipping is an evil, and the case of the Pullman cars is but one of many creating a servile class of men that relies upon boot-licking as a means of making a livelihood. Hotel servants, and those in public restaurants are even worse than those in sleeping cars. In many respects those who tip are far more to blame than those who are tipped. The advent of the Pittsburgh millionaire created a new scale of rates for personal service in New York, and the man who is traveling on an expense account is even worse. The fact that he is spending money other than his own seems to make him reckless to the point of prodigality, and the result is that those whose sense of the fitness of things makes them consistently adhere to the 10 per cent rule have to put up with indifferent service, and even at times none at all. When individuals are willing, even anxious to pay large premiums for the privilege of checking hats and wraps in the large public restaurants, a service which is theoretically at least rendered gratis by the proprietors, is it not time to stop theorizing on the cost of high living and ask ourselves how much we individually are contributing toward the creation of an artificial condition of extravagance and waste? Since the jurisdiction of the California Railroad Commission seems to radiate outward in all directions, why not ask the Tippers Union to reduce their scale of gratuities?

PARTICULARS as to the terms of the agreement between the Chinese Government and the Standard Oil Company with respect to the development of the Chinese oil lands has been made public in a recent issue of *Oildom*. The high contracting parties representing the Chinese republic are Hsiung Hsi-ling, Premier; Chow Tsz-chi, Minister of Finance; Chang Chien, Minister of Agriculture and Commerce; and Chu Chi-chien, Minister of Communications; while for the Standard Oil Company of New York, Mr. Henry J. Everall appeared as attorney. The Company agrees to send experts to make a thorough examination of the Yen-Ch'ang, Yen-An-Fu, and adjoining fields in Shensi province and Chengtehfu (Jehol) and adjoining fields in Chihli province. The Government agrees to provide all necessary escort, interpreters and military sufficient to insure the safety of the expedition, while the expenses are to be borne jointly by both parties. When the examination and prospecting work shall have been carried far enough along to demonstrate the advantages of working the fields, an American-Chinese company is to be formed, chartered in the United States and shall begin operations within six months after completion of the survey. The capitalization shall be 55 per cent Standard Oil Company and 37½ per cent Chinese Government, the latter as compensation to it for the franchise. The Government has an option to purchase 7½ per cent additional at par within two years after formation of the corporation, and if this option is not exercised, it shall remain with the Standard Oil Company. The ownership of the Chinese shares may not at any time pass from the ownership of the Chinese Government. The management and control of the Company is to be vested in a board of directors in the proportion of the allotment of shares. Chinese citizens may purchase shares of the Company in the open market. The Company is given exclusive right to work and develop the territory mentioned, and also agrees to give to no other foreigners any monopolistic concession whatever as far as petroleum-bearing territory is concerned. It would appear that this agreement would make interesting reading in Great Britain, especially in the offices of Pearsons Sons, Limited.

NOW comes the Southern Pacific Company in the person of its attorneys before the California Railroad Commission on the subject of passenger rates on its Alameda county suburban lines. For many years the commuter has enjoyed a monthly rate of $3, good for one round trip daily, and while this rate is admittedly very low in proportion to the service rendered, at the same time it has become so much of a habit that in view of the approaching state election, it is unlikely that the railroad company will be permitted to increase it to any great extent. Figures, reports, and other data by the ton bearing on the case have been carted to the offices of the Commission by the Company in order to furnish evidence that their request is a just one. The following figures submitted by the railroad company afford an interesting index of the situation:

TRANSBAY SUBURBAN LINES, JANUARY TO APRIL 1914, INCLUSIVE

	Electric.	Ferry.
Gross operating revenue	$298,538.61	$228,382.75
Operating expenses	354,294.61	234,719.15
Deficit	$55,756.00	$6,336.42
Other expenses, taxes, etc.	60,228.07	10,848.18
Deficit	$115,984.07	$17,184.60
Interest on investment for 4 months	570,531.34	49,054.23
Total deficit	$686,515.41	$66,238.83
Total ferry and electric		$752,754.24
Average annual deficit		2,258,262.72
Capital investment, ferry		2,102,324.44
Capital investment, electric		24,451,343.04
Total ditto		$26,553,667.48

THE Company has declared further that it loses 11.81 cents on every suburban passenger transported. Appreciating the effect that an increase in commuter rates would have on the growth of the suburban territory along the east bay shore, the Oakland Chamber of Commerce is represented at the hearing by counsel which will endeavor as far as possible to prevent the allowance of any increase. There are of course many ways of figuring costs of such a service, and still more ways of distributing the burden over the different classes of traffic. It would appear in this case that the Railroad Commission has a difficult knot to disentangle with justice to both sides.

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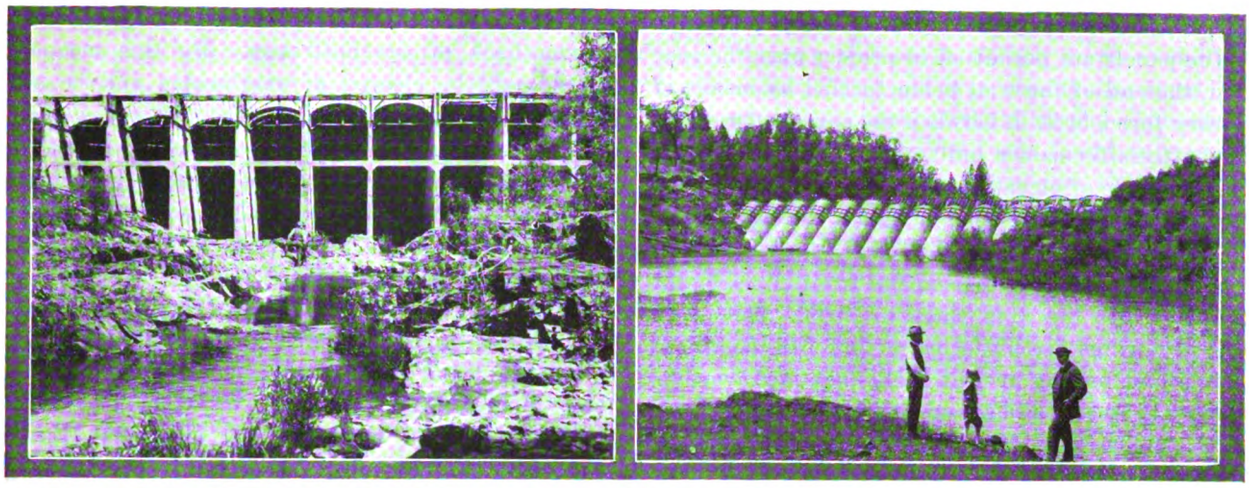

DOWNSTREAM SIDE OF DAM, SHOWING ENTIRE STRUCTURE. UPSTREAM SIDE OF DAM, SHOWING FILLING OF RESERVOIR.

Los Verjels Dam, a Multiple Arched Structure

By JOHN S. EASTWOOD*

Los Verjels Land & Water Company is the owner of a large tract of rich olive land in Yuba and Butte counties, California, lying in the vicinity of and surrounding the town of Bangor in Butte county, not far from Oroville. This land, when irrigated, produces the finest olives and citrus fruits as is evidenced by the now famous Palermo colonies. Without water these lands are useful only as pasture land during part of the season.

Dry creek is a branch of the main Yuba river rising in the lower reaches of the Sierra Nevada mountains east of Forbestown and produces a large winter water supply, though nearly dry in the fall of the year. The greater portion of the drainage area is of comparatively low altitude, hence the winter storms fall as rain, and run off as torrential freshets. It is to store part of this winter run-off that Los Verjels Land & Water Company built Los Verjels dam on Dry creek, which is about one mile north of Oregon House post-office in Yuba county, California. The dam is a structural dam of the Eastwood multiple-arched type designed to meet the conditions at the site and forms a reservoir that will contain about 2600 acre ft., which is to be used to supply water, during the dry months of the summer and fall, to the lands of the Company. The present dam is built to a height of 60 ft. and has a crest length of 350 feet. It is so designed that the base of the dam may be eventually built up to a height of 90 to 100 feet. The Eastwood multiple-arched dam is a structural dam using arches for the water face and buttresses for its support. In the present case, the span is 20 ft. from centre to centre, the slope of the water face at the crown line being one to one and the backs of the buttresses being built vertically. The dam consists of 17 buttresses supporting 16 arches, so arranged that the structure can be continued to the eventual height of 90 to 100 feet. The unit stress or allowable load for the arch rings in compression is 18 tons per square foot. The arc of the extrados of the arch rings is 144°30′, the radius being 10.5 feet. The radius of the intrados or inside of the arch is fixed by the required thickness of the wall to meet the unit loads in each part of the height in the structure, and therefore changes to meet these conditions at the different heights. The buttresses are separated and supported in their rigidity by means of strut-tie members. They are so disposed as to take up any stresses that may be set up by vibrations. These strut-ties also divide the buttresses into the equivalent of short columns, giving them great stiffness. The bed of the stream at the site has been swept bare of all over-lying material and the irregular projections of the rock are made smooth by the water flowing over them. The rock consists of a very hard blue porphyrite, there being a small amount of overburden over it on both sides of the canyon, which overburden is stripped off until sound rock is found upon which the structure is located, so that there is a bedrock contact throughout all parts of the structure. The bedrock is roughened up by means of small shots, and all loose particles and spalls are removed, the rock being washed clean by means of a hose jet under pressure. As it is essential to form a good cut-off wall, the foundations for the arch ring walls are particularly carefully prepared so that there can be no seepage through the rock, all loose seams being worked out before the concrete is allowed to be placed.

The concrete is placed in wooden forms. Those for the buttresses consist of panels made from 2 by 4-in. studs and 1-in. boards, these panels being 4 by 8 ft. in size, so that they may be handled from place to place. The panels for the sloping portions of the buttresses

*Consulting engineer, Hearst Bdg., San Francisco.

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are made to conform with those of the front slope, while the panels are permitted to project over the rear portion, the end of the wall being formed by means of temporary forms built in between the panels. The bases of the buttress forms are built up until they meet the regular multiple of elevation so that the 4-ft. panels on all buttresses are of the same height at the top.

The buttresses are carried up first, short pieces of rods being left protruding from the front edges of the buttresses to tie the arch rings to them. The forms for the arch rings are made by cutting 1-in. boards to the circle and nailing two of them together over-lapping so as to form a liner, and to these as a guide the studs are nailed in 8-ft. lengths, and placed about 20 in. centres apart. Over these studs are bent ½ by 6-in. boards which are nailed to every stud, forming a sheeting over the entire surface. The whole surface is then covered with tarred building paper tacked to the forms, the edges of the paper being lapped. The outer forms for the arch rings are made up in panels and spaced away from the inner forms to give the required thickness to the walls, the outer forms being all the same radius are made up of uniform sized panels so arranged that a set of four panels will complete the arc of the arch rings, each panel being about one-fourth of the length of the arc of the arch.

The reinforcement for the buttresses, besides that used to tie the buttresses and the arch rings together, consists of rods left protruding in sunken panels in the buttresses for tying on the extensions to the buttresses when made, these recessed panels being in the sides and ends of the buttresses. It is the intention, when the extension of the dam is made, to drill holes for rods that will pass entirely through the present buttresses, these rods to be bent so as to tie the extensions firmly to the old work.

The reinforcement for the arch rings consists of Clinton electric-welded mesh which is placed in two layers at about 2 in. from the inner form and the other about 2 in. from the outer form. Twisted steel rods are used for reinforcing the strut-tie beams which run continuously through from end to end of the structure. The concrete is made from the bank gravel hauled from a large deposit of clean water-washed gravel a short distance from the structure and as an equivalent of 1:2:4 mix if broken stone is used. The concrete is mixed in a batch mixer and conveyed in concrete buggy barrows to the work on a wheeling platform maintained across the buttresses. The tamping is done by means of wooden tamping poles and also by means of tapping with wooden mallets the outside of the forms, vibrating the concrete into place. The structure is finished and waterproofed on the water face by using a coat of plaster applied to a thickness of ⅝ in. by means of a cement gun.

The dam, being a base for a larger section, is finished temporarily at the top with spillways at each end, where wooden spillway floors are carried out to the back edges of the buttresses and the water allowed to spill on the bedrock and run down to the centre of the canyon back of the buttresses. By this means the ground will be cleared of overburden and be swept clean for extending the dam when it is desirable to build it to the full height. In two of the arches near the bottom sluiceways are provided to permit the flood waters in the earlier part of the season to flow directly through the dam. These sluiceways will be closed by means of stop logs in the latter part of the winter, thus allowing the reservoir to be filled full to the spillways.

Flash boards are provided in the spillway openings so that the water may be carried to the extreme top of the structure, after the period of freshets has passed by. The water for irrigation will be drawn from the dam through two 14-in. valve gates provided with screens. Throttling gates are provided at their downstream ends. The concrete is made from the bank run gravel from the creek bed, the natural mixture being in the right proportion to make a good strong concrete.

The contractor's plant is extremely simple, the only power used being for running the concrete mixer and for operating a pump to raise water from the creek for concete mixing and washing foundations, forms, etc. The concrete was placed by means of Ransome concrete buggy barrows, and a hopper chute to convey it to the forms.

This work of construction was done by the Chico Construction Co., of Chico, California. The concrete was placed on the basis of a unit price per cubic yard in place, including all material and excavation and the extra work of excavation and setting gates was done on the basis of cost plus a fixed percentage for superintendence. The work has been carried on during the entire time of the past winter, being commenced in October 1913, and was only stopped during the most severe storms. When the work was begun in October, the flow in the creek was but a few miners inches and this was by-passed by means of a small flume through one of the sluiceway openings until the sluiceway was completed, after which it was turned through the opening of the sluiceway. The winter of 1913-14 was notable for its extreme high water freshets and for the excessive precipitation. During the big storm of December 1913, precipitation at a number of mountain recording stations exceeded the record made for 24 hours during the past 60 years or during the period in which records have been kept. This will indicate that the flood produced by the run-off must have been extreme during this period. The precipitation recorded was from 9 to 12 inches in 24 hours at various points lying on both sides of the headwaters of the Dry creek.

It was the plan to carry up the whole base of the dam above bedrock of the creek the same distance, leaving the two sluiceways open to pass ordinary winter floods as they would occur, but owing to the unusual winter conditions the sluiceways could only handle part of the water. The dam was up to about 20 ft. in height above the low mark at the time of the first big freshet, the forms having been carried up to a greater height

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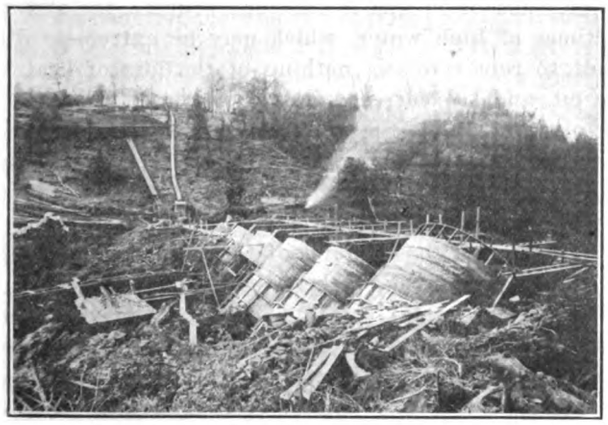
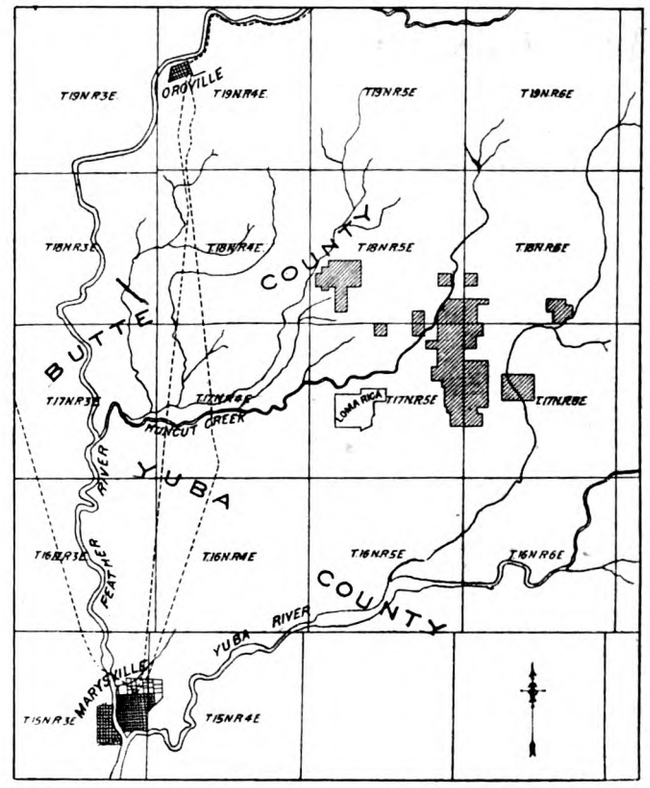
on the downstream side of the arch rings. The flow of water was so great that in addition to the capacity of the openings provided, the water passed over the top of the crest of the freshly built dam to a depth of 6 ft., carrying logs, trees, and driftwood in great quantities over the freshly laid edges of the arch rings. The water carried away both projecting upstream and downstream forms and tangled up the reinforcement that protruded from the concrete and also carried away a considerable amount of lumber that had been delivered for the making of forms in the creek bed below the high-water mark. The base of the buttress on the south side of the creek had just been poured and as it stood on the bedrock above the level of the crest of the part of the arch rings that had been finished, the water passed along the upper side of it creating a heavy side pressure which upset the base of the buttress, as there were no braces of any kind used to stay the forms. This small amount of concrete tipping over sidewise was the only damage done to the concrete, the damage consisting of the destruction of forms, loss of lumber and reinforcement. A careful inspection of the edges of the concrete over which the water passed showed absolutely no wear or abrasion, though the concrete was less than two weeks old at the time the flood occurred.

Illustration below shows condition of the dam shortly prior to occurrence of the flood. In this picture is seen the water being conveyed through the flume from a little sack dam built a short distance above the dam in the creek bed. The lumber piles left were carried away by the freshet and the buttress to the left of the picture is the one that was overturned. No damage of any kind whatsoever was done to the arch rings, the water passing over them, and leaving them intact except for the stripping of forms and the tangling of the reinforcement. The severity of this flood and the condition of the concrete at the time of its occurrence proves more than any other occurrence could, the great strength of this type structure. The factors of safety in Los Verjels dam are very high, being more than double those allowed in the city building codes of San Francisco, and thus it will be seen that it is an exceedingly strong structure. The foundation is the best that could be had, being a very hard porphyrite, very irregular and rough on the surface, and having tight seams. The dam was rigidly inspected by the Engineer Department of the Railroad Commission of the State of California, and was found as represented to be in good condition. This dam is unique in this respect, that it will be the cheapest permanent dam of its size that has ever been built. This structure is stronger than would be a solid masonry dam, and at the same time has cost less than a third of what a solid masonry dam with equal stresses in compression would have cost at this site. This type of structure is an ideal type for irrigation dams and power construction where the investment must be kept at as low a point as possible. The great feature of this type of construction is that while it is the cheapest known, yet at the same time it is one of the strongest and safest. There are many irrigation projects that cannot stand the cost of storing water with the older types of dam because the investment would be beyond the possibility of profit on the venture, but by the use of this type of construction there are many projects that would otherwise be unprofitable or doubtful which are immediately removed into the class of the profitable investments.



CONDITION OF WORK JUST PRIOR TO FLOOD OF DECEMBER 1913



MAP SHOWING POSITION OF LOS VERJELS IRRIGATION PROJECT.

F. H. Newell says: "In other words, we may design a structure on thoroughly scientific lines and without the unnecessary waste of material which is found in the usual solid dam. These multiple arch or composite dams are especially suitable for conditions where economy of material is a prime requisite or where the foundations are of a somewhat doubtful character."

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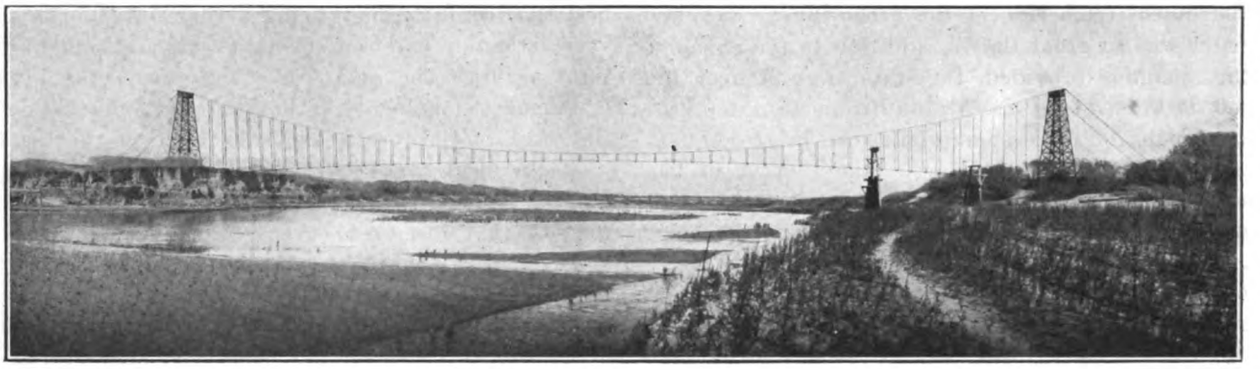

Associated Oil Company's Oil Line Suspension Bridge Over the Salinas River

By C. E. BEATIE and C. P. BOWIE*

The 6-in. oil pipe-line owned by the Associated Oil Company extends from Coalinga in Fresno county to Monterey bay in Monterey county, a distance of about 110 miles. It has for the past 10 years been an important factor in the transportation of oil from the West Side fields of the San Joaquin valley in California, to tide-water. The route of this line leaving Coalinga, follows along the canyon of Wartham creek to its junction with Salt creek, thence ascends rapidly through the gorge of Salt creek, crosses at an elevation of about 2600 ft., the main divide of the Mt. Diablo range at Priest valley, some 25 miles distant from the initial pumping station at Coalinga, having gained in elevation in this distance about 1800 feet.

From Priest valley the course of the line continues in a general northwesterly direction along Lewis creek, and thence across the rolling foothill territory of the western slope of the Diablo range to a point near the head-waters of Chalone creek, the tortuous canyon of which it follows until emerging into the Salinas valley near Metz, a station on the Southern Pacific railroad, 9 miles south of the town of Soledad. Hugging the easterly foothills of this valley to give the uncertain channel of the Salinas river as wide a berth as possible, the pipe parallels the railroad tracks to a point a short distance south of Chualar, where, turning abruptly to the west, the river is crossed on a 600-ft. suspension bridge, and practically a tangential line passing at a low elevation over the extreme northerly end of the San Antonio range is followed to the terminal at Monterey.

The country traversed, especially along the more elevated ridges of the Diablo range, between Coalinga and Metz, is of a semi-arid nature, the greater portion being without forest covering and much of it even without brush, bearing only a growth of grass or wild oats, the abundance of which is dependent on an erratic rainfall. Coupled with this lack of vegetation, the further fact that the geological formation of the region consists primarily of shales, limestones, and soft sandstones, it is not surprising that one should find flashy torrential streams, having a heavy discharge in winter, and in summer practically no run-off whatever. These streams have cut into the foothills deep canyons, whose precipitous sides and tortuous courses present many difficult engineering problems where necessity demands that they become the route of a pipe-line.

It is a notable fact that in Wartham canyon in a distance of 18 miles, the line crosses the creek 23 times, while in its course through Lewis canyon 38 crossings are made in 15 miles. Where the stream has cut a channel down to bedrock, a satisfactory crossing can usually be made by placing the pipe in a ditch cut well into this hard formation below the floor of the stream, and back-filling with a mixture of sand and rock. In the majority of cases, however, the streams carry so much alluvium and shifting sand, that such a method of crossing becomes impractical, if not impossible. Moreover, in general, underground crossings are not to be desired, in that there is always the danger of collar leaks or breaks in the pipe beneath the stream in times of high water, which may be extremely difficult to repair to say nothing of the loss of heat in the oil, and the correspondingly increased friction in the pipe-line due to the cooling effect of the water. So it is that in the majority of places the pipe-line is carried over the streams and experience has shown that the most satisfactory all around method of doing this is through the medium of the suspension bridge. There are a number of these structures in use along this line varying in length and size of towers from those required to span a waterway 50 ft. in width to the one already mentioned as crossing the Salinas river near Salinas, which it is the purpose of this article to describe.

*Engineers, Associated Pipe Line Co., Sharon Bdg., San Francisco.

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This structure is unique in that it is the longest pipe-line suspension on the Pacific coast, having a span of 600 ft. from tower to tower. It carries one 6-in. oil pipe-line, which together with cables, hangers, decking, etc., comprises a dead load of about 35,000 pounds. Two cables are used supported by wooden towers on either bank of the stream; the cables being anchored to reinforced concrete deadmen. The bottom of the bridge is 30 ft. above the bed of the river, and about 15 ft. above the extreme high water mark. The deflection of the cables is 0.1 of the span or 60 ft. and the bridge has a camber of 0.01 of the span or 6 ft. The tension on each main cable is 47,000 pounds.

The valley of the Salinas at this point is about 3 miles in width. Its floor is composed for the most part of sand and loose alluvial soils, which offer small resistance to the cutting effect of flood waters during the rainy season. For this reason the river bed is an uncertain and constantly changing quantity. Although thorough search was made to find a crossing where the banks were of such a nature as to afford reasonable security against this scouring, the best that could be done was to select a place where one bank was a relatively high bluff of adobe and clay formation, shown on the left in the accompanying illustration, toward which the current was working, and the other sand-dunes thrown up by back water during the flood seasons and which are now covered by a dense growth of willows and underbrush.

Protection has been provided for the high bank side by means of a jetty several hundred feet in length, built out into the river on the upstream side and constructed so as to turn the direction of flow toward the opposite bank of the stream, the idea being that its covering of vegetation will offer sufficient resistance to break the velocity of the current before appreciable damage by scouring can be done. The added precaution was also taken to cover this high bank, immediately above the tower foundation, with a thick mat of green willows woven with wire and weighted down with concrete blocks, every encouragement being given sprouts from the sappy branches of the enmeshed mat to the end that in time this bank of the river might also be covered by a growth of willows.

Foundations.—The tower on the high bank is set over six concrete piers each 4 ft. 6 in. by 6 ft. on the bottom, 3 ft. 6 in. high, and 2 ft. 3 in. by 3 ft. 3 in. at the top. On the low bank the tower is set on a pier, the top of which is 10 ft. above the ground line. This pier is shaped like an ordinary bridge pier, and is pointed on both the upstream and downstream sides. It is 60 ft. long, 22 ft. wide, and contains fifteen 60-ft. creosoted piles driven 50 to 60 ft. into the quicksand. Nine of the piles upon which the direct weight of the tower rests, form a rectangle having its longer axis parallel to the direction of the current. Three piles each, on the upstream and downstream sides, were driven in the shape of triangles, affording a protection to the main foundation against drift logs, and forming the wedge-shaped portions of the pier.

The piles are braced with three sets of 10 by 10 in. redwood chocks, one set placed at the ground line, one at the top of the pier and one at a point midway between. These chocks are held in position by thirty sets of cross-braces. The outside of the pier is planked with 4 by 12-in. redwood spiked to the piles, and the entire structure contains a total of 21,000 board feet of lumber.

Towers.—The towers are constructed of select Oregon pine and are similar in design to an oil well derrick, except that they have six legs instead of four and that the corners are reinforced on the inside by 6 by 6-in. posts. They are 66 ft. high with bases 17 ft. 6 in. by 24 ft., and tops 5 ft. 6 in. by 12 ft. Each one contains 7500 board feet of lumber.

Deadmen.—The deadmen are made of concrete thoroughly reinforced with 1-in. iron rods. The one on the high bank is 165 ft. back from the tower and is 20 ft. long, 4 ft. 6 in. high and 3 ft. 6 in. wide; placed with the broad side facing the tower. In setting the deadman on the lower bank, quicksand was encountered so that it was found necessary to place it on a pile foundation, seven piles 40 ft. long being driven for this purpose. Each deadman is about 6 ft. below the surface of the ground.

Cables.—The suspension cables consist of two 1⅛-in. galvanized trackstrand solid case cables 929 ft. long, which were made to order. They are spaced over the towers 15 ft. centre to centre, and rest in cast iron shoes on 18 by 18-in. pine caps. To provide for the necessity of taking up slack in the cables from time to time after they were put into service a 2½ by 24-in. turnbuckle is fitted to the ends of each by means of a 1¼-in. rope socket. In case the required amount of slack to be taken up should exceed the limit of the turnbuckle, a 1¾-in. stud-link chain is placed between the anchor bolt in the deadman and the lower rod of the turnbuckle to which it is fastened with a 2-in. chain shackle; the idea being, that should this circumstance arise it would be possible through the use of a block and tackle to remove the pin from the shackle and by extending the turnbuckle fasten the shackle to a lower link in the chain.

The lower end of the chain is shackled to the eye of a 15-ft. tie rod or anchor bolt, the eye on the other end of which fits over a 10-in. pipe, 19 ft. long, running lengthwise through the centre of the deadman. From the deadman up to a short distance above the surface of the ground the tie rod and chain is encased in a piece of 8-in. pipe, which, when the structure was complete and carrying its full load, was filled with a mixture of sand and cement to protect that portion of the rod and chain beneath the surface from rust.

The tendency of the cables to come together between the towers, under load was remedied by placing spreaders, made of 1½-in. extra heavy pipe flattened on the ends and fastened to the cables with ¾-in. clip bolts every 20 feet. These spreaders are of such lengths that the projections of the cables on a horizontal plane would form approximately two parabolic curves hav-

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ing a base of 600 ft. and a height of 6 ft. By using two cables and tying them together in this manner the structure offers more resistance to the wind than if a single line were used.

Pipe Deck.—The deck which carries the pipe is hung from the two main cables by hangers of ⅜-in. galvanized iron strand spaced 10 ft. apart. It is made of 6 by 6-in. cross-ties, 3 ft. long, which carry for flooring, two strings of 2 by 10 in. by 20-ft. plank spaced 10½ in. centre to centre and breaking joints on the cross ties. This leaves a space between the run boards of 5½ inches in which the pipe-line rests. The pipe is strapped to the cross-ties at every fourth joint.

Hangers and Hand Lines.—The hangers consist of ⅜-in. galvanized strand, one end of which is turned over the cable and fastened with two Crosby clips. The other end is spliced into the eye of a ⅝-in. turnbuckle eye bolt. The lower bolt of the turnbuckle is welded into a ⅝ by 9-in. eye bolt, which passes through the 6 by 6-in. cross-ties supporting the run boards.

A hand line of ⅜-in. strand is fastened to the hangers by clips, and is run along each side of the bridge about 3 ft. above the deck.

As an additional protection against wind stresses swaying the structure and causing collar leaks, two ⅝-in. galvanized plow steel cables are fastened to the bridge on either side at hangers numbers 20 and 40 (position of these hangers being ⅓ and ⅔ the length of the bridge), and are anchored to the banks of the river. On the high side they are made fast to reinforced concrete deadmen, which are about 25 ft. on either side of the centre line of the tower and about 100 ft. from the bank of the river. On the lower side they pass on the outside of the extreme end piles on the pier, and are brought back and shackled to the anchor chains on the main cables.

ADVANCE DATA ON MINERAL PRODUCTION IN CALIFORNIA FOR 1913*

To obtain complete returns from the thousands of mineral producers in the state is a task which requires a great deal of time, and as has been the case in past years, final results in every detail cannot possibly be in hand before July. Answers to inquiries, as sent out by State Mineralogist Hamilton, have been received from all the operators in several branches of the mineral industry, however, and such figures as are complete at this time are tabulated below. Amount and value of the output for 1912 are also shown as an indication of the consistent growth of the industry in every line.

It augurs well for the future prosperity of the state at large that the gains here indicated give every evidence of holding true in practically all items on the list of 40-odd mineral substances which California annually produces in commercial quantity.

Following is tabulation of substance concerning which final returns for 1913 are available, to date:

	1913.		1912.	
Substance.	Amount.	Value.	Amount.	Value.
Cement, bbl.	6,167,806	$7,743,024	6,198,634	$6,074,661
Chromite, tons	1,180	12,700	1,270	11,260
Coal, tons	25,198	85,809	14,848	39,092
Graphite, lb.	2,500	25	.....	.....
Infusorial earth, tons	8,595	35,760	4,129	17,074
Iron ore, tons	2,343	4,485	2,508	2,508
Marble, cu. ft.	41,654	113,282	27,820	74,120
Pyrites, tons	79,000	218,537	69,872	203,470
Pumice, tons	90	2,000	100	2,500
Tungsten ore, tons.	7,592	234,673	8,042	206,000
Total		$8,450,295		$6,630,685
Increase in value of above ten mineral substances				$1,819,610

*Reported by the California State Mining Bureau.

ERECTING A 100-FOOT STANDPIPE BY HAND

Neither steam nor electric power was utilized in the erection some time ago of a 20-ft. standpipe 100 ft. high for New York City at Silver lake, Station Island. The bottom of the standpipe consists of two ½-in. plates united by a diametrical-strap spliced joint. In order to give clearance for the pipe connections through the plates and to insure that the plates were properly bedded on the cement mortar covering the foundation pier, they were temporarily supported on a number of vertical wooden struts seated on the pier. Each strut was made of a pair of 12-in. planks 30 in. long nailed together at right angles to form L-shaped columns.

As no derrick was conveniently available for handling these heavy bottom plates, a large number of loungers were induced, by the payment of $5 to treat the crowd, to lift the plates bodily and hold them up until the temporary supports were placed under them.

Provision for lowering the plates to their mortar bed was made by nine 1⅞-in. holes through each half of the bottom. These holes were tapped for standard bolts and the latter, provided with full-length screws, were engaged in them and acted as jackscrews by which the plate was gradually lowered to position after the wooden supports had been removed. Subsequently the jackscrews were detached and the holes at the sides were permanently filled with screwed plugs calked in position.

The 5-ft. courses of the standpipe shell were erected by a gin pole made of 20-ft. lengths of 12 by 12 and 10 by 10-in. timber. A 10 by 10-in. timber fitted at the upper end with connections for guys and tackles was seated on the base plate at the centre and guyed to adjacent trees. After the lower courses of the shell had been erected, the guys were loosened and the gin pole was hoisted high enough to permit the insertion underneath of a second 20-ft. length of 10 by 10-in. timber, which was securely spliced by four 3 by 15-in. wooden slabs 12 ft. long, securely bolted. These slabs being wider than the timber, each projected on one side, giving the splice additional stiffness. The gin pole was equipped with a hand crab and the work was executed in six weeks by a force of ten men under the direction of R. Dunseath, of New York City.—*Engineering Record.*

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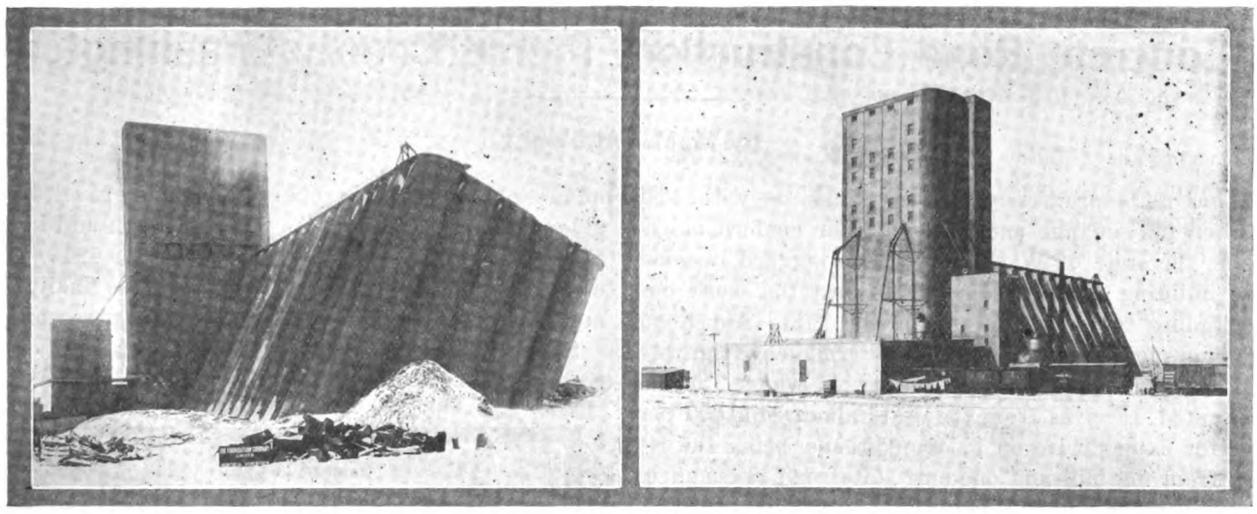

VIEW FROM NORTHEAST.

VIEW FROM SOUTHEAST.

Restoring the Canadian Pacific Grain Elevator at North Trascona*

It is an unforunate fact that dams sometimes fail owing to poor foundations. It is, however, a rare occurrence when a building fails in the same manner, and the spectacular settlement last autumn of the Canadian Pacific grain elevator at North Transcona, Man., to an angle of 27° from the vertical, is therefore quite noteworthy. It has been stated that it is the first case of this nature which has happened on the American continent.

Hence, a brief description of the methods employed by The Foundation Company Ltd. (the contractors for the restorative work) to bring the building back to the vertical again, will be of considerable interest to engineers and contractors.

North Trascona is on the main line of the Canadian Pacific railway, six miles northeast of Winnipeg. Limestone rock (of the Ordovician age) underlies the site fairly uniformly at a depth of 53 ft. from the flat prairie level. Starting from the surface, the materials encountered down to bedrock are 35 ft. of stiff blue clay, 7 ft. of soft white clay and boulders, 7 ft. of harder white clay and gravel, and 4 ft. of shattered limestone embedded in marl.

The elevator is divided into two sections, the workhouse and the storage bins. Both of these are built of reinforced concrete, the workhouse portion being 70 by 96 by 180 ft. high, and the bins being 77 by 200 by 90 ft. high.

It was considered sufficiently strong to place these buildings on a reinforced concrete mattress (27 in. thick) some 15 ft. below the surface at the workhouse and some 10 ft. under the tanks, the assumption being that with careful loading the building would settle into clay steadily and uniformly until refusal. However, when the bins were actually loaded, a different result followed.

On Oct. 18, 1913, when 875,000 bushels of wheat had been placed in the bins, a vertical settlement of about 3 in. took place, after which the whole storage tank section settled over to the west (the longer axis being north and south) and continued to settle until it came to rest, 24 hours later, at a final angle of 27° from its original vertical position. The western edge of the mattress sank 26 ft. and the eastern side was raised 5 feet. Recent borings with a diamond-drill have proved that this settlement to the west was caused by an unsuspected ledge of limestone rock on the east side rising to a height of 12 ft. above the main bedrock and sloping rapidly toward the west.

The Canadian Pacific Railway decided to restore the bins to approximately their former position, and entrusted the solution of this problem to The Foundation Company, Ltd., of Montreal and Vancouver.

It was clearly seen that the first step was to ensure the safety and stability of the workhouse, weighing 20,000 tons, which, so far, had remained intact. This work was commenced on Dec. 15. Twenty-four concrete shafts were sunk to the rock, under the existing columns of the building, and, around the outside, 20 more concrete shafts were also sunk to the bedrock, from the tops of which heavy shoring pieces were placed to bear against the sides of the building.

Meanwhile work was commenced on the underpinning work in connection with the storage bins. There are, at present, 65 bins in 5 rows of 13 each, and it is proposed to sink 70 shafts or piers under these in 5 rows of 14 each—each pier to be 6 ft. 6 in. diameter and to rest on bedrock. Since these tanks weigh, even when empty, some 13,000 tons, it can easily be seen that difficulties were encountered in sinking.

*From data supplied by The Foundation Co., Dominion Trust Bdg., Vancouver, B. C.

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Concrete Road Construction, Pierce County, Washington

By M. M. CALDWELL*

Being ultra progressive in all things, as witnessed by women's suffrage and various other modern movements, the state of Washington is no laggard in good road building and for some years past the work has been going forward, first under the State Aid Road Law and more recently under the Permanent Highway Act. Under this act, Pierce county, in which Tacoma is situated, receives from the state about $150,000 per year for expenditure on its trunk roads, being the return from the mill and one-half state road tax, and in addition to the county's own road and bridge fund provides the amount of $200,000, which sum is divided among three commissioners' districts pro rata with the taxes received from each district. This seems like an exceptionally large amount for a community to expend annually for roads, but even this amount is unequal to the demands made upon it, and many communities are practically roadless or are served by some pioneer trail.

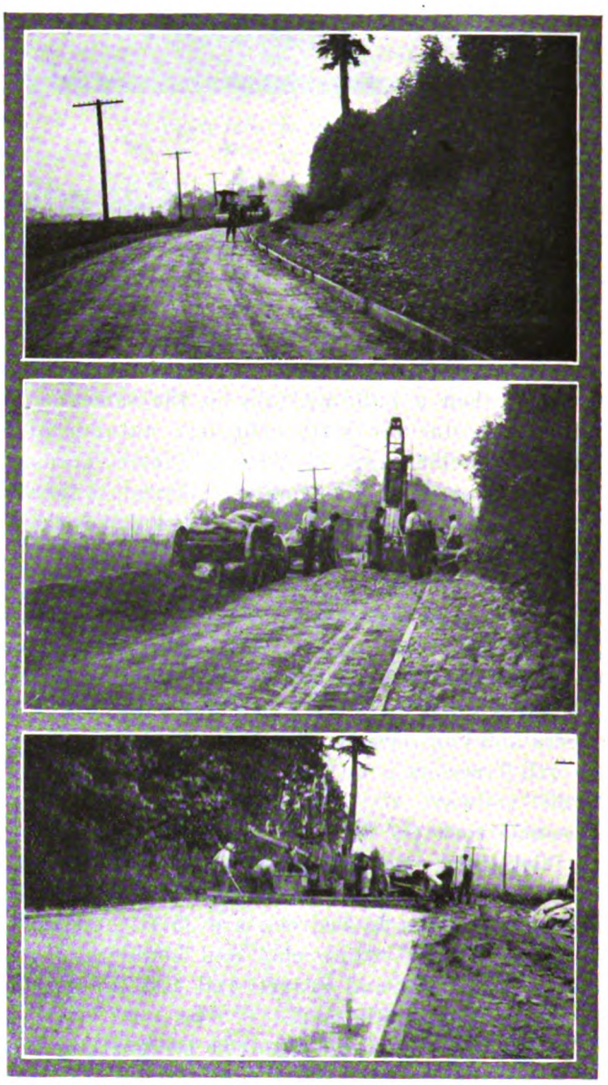
In the East, where the country has been settled more or less slowly, the roads have developed with the population, but the local situation is, that even in the cities, the gain in population has been greater than the ability of the officials to provide for their requirements, especially as much of the work must necessarily be quite heavy and expensive, owing to the physical conditions and the heavy expense of clearing due to the exceptionally large timber which grows in the Puget Sound country.

Up to the past few years all work has been done along the lines of opening up new roads and maintaining those opened, all of which have been dirt roads usually surfaced with gravel, which is plentiful in most localities; but with the rapid growth of the suburban towns and the development of the auto-trucking business between them and Tacoma there has been a demand for something better.

Some five years ago, answering this demand, an oil macadam road was constructed, but the results were so unsatisfactory and it was so evident that macadam construction was unsuited to our climatic conditions that no more will be attempted.

The next attempt at hard surfacing was in 1912, when a contract was let under the Permanent Highway Act, for some 10 miles of 16-ft. granitoid pavement at a price of $1.40 per square yard to the Washington Paving Co. of Tacoma. This pavement has proved very satisfactory, but having such large demands upon the funds and desiring to make them go as far as possible, the Commissioners sought for some less expensive construction, and in view of the very favorable reports of the one-course concrete pavement in Wayne county, Michigan, and elsewhere, and the abundant supply of excellent sand and gravel obtainable locally, decided after much discussion and investigation to adopt this type of pavement for 1913, to the elimination of all other types, and this was finally done and some 15 miles constructed during last season.

Specifications for the work were drawn up by C. H. Sweetser, formerly chief engineer of the State Highway Department, assisted by the writer on details covering structural design, bridges, culverts, etc., and in the main, called for a one-course concrete pavement of 1:2:4 mix, 5 in. thick, 16 ft. wide, and widened on curves to 20 ft., and also given a varying super-elevation on curves similar to work done by Mr. Sweetser the previous year.



ROAD ROLLER HAULING TRAIN AND COMPACTING SURFACES.
LOADING-END OF TRACTION CONCRETE MIXER.
No. 11 KOEHRING PAVING MIXER WITH BOOM DISCHARGE.

*Highway Engineer, Tacoma, Washington.

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CLAM-SHELL BUCKETS UNLOADING AGGREGATES.

DETAIL OF UNLOADER ARRANGED FOR QUICK MOVING.

The most unusual item of the specifications, perhaps, was that expansion, or contraction joints, as one may be disposed to call them, were only to be placed at the end of the day's run, which resulted in stretches of from 400 to 500 ft. between joints, of which more mention will be made later.

Bids were opened for two pieces of the work on March 22, 1913, with the same bidder low on both jobs, and in view of the fact that it was desired to finish the work as early as possible, and the low man wanted to finish one job before starting the other, and also that the Commissioners wanted some first-hand evidence as to the cost as well as definite knowledge that the specifications had been carried out, they decided to let only the one piece and to have the other done by their own force.

With this in view, one piece of work, about 4½ miles in length, was let by contract at the bid of 86c. per square yard, and the other piece, some 4 miles in length, on which the bid had been 88c. per square yard, was turned over to the writer, who was given full authority by resolution of the Board, to organize such crew and purchase such equipment as might be necessary for the proper conduct of the work.

Acting with this authority, the writer proceeded first to organize a grading crew to handle some 10,000 yd. of dirt involved, and having that work started, preparation was made for the concrete work to follow.

The work paralleled the main line of the Northern Pacific railway, lying within 100 ft. of it most of the distance, and at a favorable location near the middle of the job the railroad was induced to place a spur track on which all sand and gravel was delivered, and a warehouse was built to hold three cars of cement, one end being used as an office.

On the road alongside of the spur, a 10-ft. gauge track, 200 ft. long was laid, the grade of the spur being about 4 ft. below the grade of the road, and a small traveling derrick was constructed with a 7 by 10-in. Clyde 2-drum bull-wheel engine mounted thereon to operate a clam-shell bucket for unloading materials as needed.

A separate drum and counterweight was rigged up to operate the bucket which was an Owens 2-line, one drum of the engine being used to operate the boom and the other the closing line of the bucket. The rig in question had been previously used by the writer for controlling a gravity tramway, but was used without any change except the substitution of a foot-brake in place of the hand level which had been used in the first instance.

Owing to the limited space available, the derrick was only 10 ft. wide, with a 40-ft. boom, and as most of the overreach was on the railroad side, the wagons to be loaded were close to the machine; a timber was bolted across the front of the machine reaching over the bank, and a strut was wedged under at each change of position, giving the equivalent of 16-ft. gauge, which proved adequate.

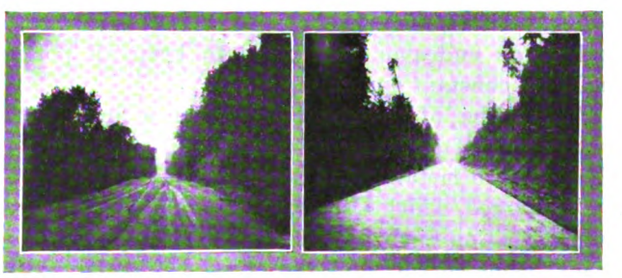
Two set-ups were made for each car as a rule, and a car of 40 cu. yd. was unloaded in one hour, using a ½-cu. yd. bucket, with an engineer and fireman on the derrick and one man in the car to clean up. Material was hauled in 6-yd. traction dump wagons, three wagons to a train with a 25-ton steam tractor using oil fuel for motive power.

This equipment answered the double purpose of hauling the materials and solidifying and rolling the roadbed, but owing to the narrow width of the roadway between strips, 16 ft., it was necessary for the road roller to follow in after the wagons each time and pull them out after they were emptied. This added considerably to the cost of hauling, but still it was much less than it could have been done in any other way, and after the continued operation of roller and traction train the road was so solid that the heavy tractors hardly made an impression on it.

After having the heavy wagons pulled outside of the ribbons, the tractor would back past and turn around and return for a new load, handling 18 yd. of material to a trip. Two machines were available and were used on the long haul, dropping to one about the middle of the haul.

The location of the spur track made the average haul only 1 mile, while if materials had come from the city we would have been unable to use the traction trains and would have had a truck haul of an average of nearly 5 miles.

Then immediately after the roadbed had been completed and rolled and several concrete culverts constructed, the concrete work was started at the far end of the work and worked to the middle, when the machine was moved to the other end and worked back to the middle again, finishing up and loading all



OLD ROAD WITH SUB-GRADE NOT COMPLETED.

THE ROAD OF THE PRESENT AND FUTURE, CEMENT CONCRETE.

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machines on cars at the spur, there being no room to store them along the finished work until safe to move them over it, as the entire road with the exception of 2000 ft. is at the foot of a ridge, with a swamp on one side and a ridge on the other and only the width of the roadway benched off. Even the derrick had to be dismantled, as it covered a portion of the roadway, leaving only room for the traction trains to pass on the inside.

The concrete was mixed in a No. 11 Koehring mixer of the boom and bucket type with traction drive and gas engine power, 1913 model. This machine was bought by the writer for the work and proved very satisfactory, having only two or three minor accidents during the work, and these were due to the operator.

Water was furnished from creeks along the road, being pumped with a 4-hp. gas engine and Fairbanks-Morse plunger pump, through a 2-in. pipe with cocks for hose connections every 200 ft. This rig was mounted on a skid and could readily be dragged from point to point. Maximum distance water was pumped was 3000 ft. and six set-ups were made for the work. The pump supplied an abundance of water, both for the operation of the mixer and for sprinkling.

Men were very scarce all season and hard to hold, as there was no convenient place to stay along the road, there being little settlement due to the hill on one side and the swamp on the other. It was finally necessary to install a camp, but even with this it was very difficult to hold men. The mixer crew was composed of only 15 men, including the foreman, divided as follows:

1 foreman	$5.00	$ 5.00
1 engineer or mixer man	3.50	3.50
1 cement man	3.25	3.25
2 spreaders	2.50	5.00
1 floater	2.75	2.75
3 shovelers, loading wheelbarrows	2.50	7.50
6 wheelers (2 sand, 4 gravel)	2.50	15.00
Total		$42.00

In addition to the above there was one man to sprinkle and look after pumping plant, which required little attention except an oiling occasionally.

The first mile of work was covered with dirt and kept wet for ten days, but the remaining portion, lying along the foot of the hill and being well protected from the sun by the tall growth, and the weather not being hot, it was concluded unnecessary to cover, especially as the character of the material available was not very satisfactory for covering, being mostly gravel, and so an endeavor was made to keep all portions moist by constant sprinkling.

The surface of pavement was given a finish with a wood float, after being screeded until all spots were filled, with a metal bound screed.

This screed, which also acted as a templet, was faced with Trus-Con curb bar of the heavy type, the rivet heads being cut off and the stems being driven into holes bored in the templet, and not only acted to smooth the surface over to the required contour, but the curved face of the metal had a compressive effect which materially aided in increasing the density of the pavement.

The mix was made just wet enough to work readily with the screed and flush the mortar to the surface and the spreaders were very careful to spread all batches and shovel the soupy portions of the mix over any places where gravel was in excess and all gravel pockets were faithfully scattered.

While this locality abounds in fine gravel deposits excellent for concrete work, most of the local market is supplied from deposits excavated and washed by the hydraulic method, and it seems certain that it is impossible to get satisfactory material for concrete road work by this method at reasonable cost.

The principal objection is that a very large proportion of fines, in some cases of which I have made screenings as high as 40% under ¼ in., are carried over with the larger material.

Again, the material being washed over grizzlies or bars set on edge, much material passes which would not pass a round hole. The dealers thought before we started work that they would be able to deliver materials up to our specifications, but it soon developed that they would be unable to do so, and in order to make any progress we had to take what they could give us. With this experience at hand, Pierce county has installed its own gravel plant for this year's work on a fine gravel deposit owned by it, and with a rotary screen is turning out excellent material, all oversize being put through a jaw and then through a disc crusher.

As mentioned before, joints were only placed at the end of each day's run.

At from twenty-one to thirty days after laying, cracks developed at an average of about 30 ft., but nothing was done with them until April 1914, when they were gone over and cleaned out with a broom and filled with a mixture of sand and heavy road oil.

Very little raveling had developed at the cracks, though the road is subjected to quite heavy traffic, largely steel tired, and has been used by heavy logging wagons carrying as many as three 24 to 40-in. by 22-ft. logs to the trip on 6-in. steel tires, and owing to the location and the inability to provide by-pass roads, traffic was over most of the work when it was from seven to ten days old, to permit ranchers to reach their homes.

Three holes, all small, developed shortly after traffic was opened on the road, but after considerable time did not show any indication of increasing in size, so were allowed to stand until the dry weather of April, when they were dug out and filled with sand, gravel, and asphalt. They were apparently due to dirty materials getting in the surface. On the whole the road is in excellent shape and bids fair to remain so with occasional attention to the cracks, for some time to come.

Especial attention was given to sub-drainage due to the location along the base of the hill, and 4-in. drains laid in gravel were placed along a large portion

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Foreman must turn in this report promptly to time keeper

DAILY TIME REPORT—PAVING

JOB .....

Pierce County Construction Department

Weather															
No. Loads Sand															
No. Loads Gravel															
No. Sacks Cement															
No. Sq. Yds. Laid															
No. Sacks Cem. Used															
NAME	RATE	Hauling Materials	Setting Strips Sta. ... to ...	Concrete Sta. ... to ...	Finishing Sta. ... to ...	Wetting Down			Gasoline	Oil	Fuel			TOTAL	
														$	

Date ..... 191.. .....

Foreman

Foreman must turn in this report promptly to time keeper

DAILY TIME REPORT—GRADE

JOB .....

Pierce County Construction Department

Weather															
Ground															
No. Slips															
No. Wheelers															
No. Wagons															
No. Fresnoes															
No. Plows															
No. Men															
NAME	RATE	Clearing—Grubbing Sta. ... to ...	Grading Sta. ... to ...	Sub. Grade Sta. ... to ...	Rolling Sta. ... to ...	Graveling Shid's Sta. ... to ...	Ditching—Tile Drains Sta. ... to ...							TOTAL	
DAYS TOTALS														$	

Date .....1914 .....

Foreman

of the work. These tile drains were opened into the catch basins for the main surface drainage and thence to the low side of the road. They are apparently very effective, having dried up much of the roadbed, which was formerly always in springy condition, and a good flow is observed at the catch-basins even in the middle of the dry season.

The low bid on this work was 88c., and after charging against the work all depreciation, interest, rentals, etc., of county equipment used, we have a cost of 81.3c. per square yard of 5-in. pavement, showing a saving to the county of some $2,500 over the low bid; after including the loss on the grading work of some 3.5c. per cubic yard, the bid being 45c. and the cost 48.5c.

Cement was handled by teams on wagons, from 40 to 50 sacks to a load, and left at mixer and pushed along as mixer moved. Two teams were used on the long haul, two wagons to each team, leaving the load and taking back the empty.

After the haul had been cut down one-half mile, one team and three wagons, with one trip of a second team near noon and again in the afternoon, kept up the supply, and after the haul had been cut to about one mile, one team was able to keep the mixer supplied, the driver being paid $1 per day extra for his extra effort and the use of the additional wagons.

Leaving the cement on the wagon and having extra wagons, works to much better advantage than stacking it along the roadway, as is frequently, or I might say invariably, done, and the wagons reduces the labor to all concerned, being kept right at the hand of the cement man all the time, and each time he takes a sack off, the empty sack is stacked on the front and returns to the warehouse with the empty wagon. In this way sacks were not scattered promiscuously around and we were charged with not to exceed 20 sacks torn, wet, or lost on the entire work.

In regard to concrete roads, the writer believes that they have a great future. However, their construction is not the very simple thing that many think, and the greatest care must be exercised at every point. Drainage or subgrade must be carefully taken care of and the roadbed should be thoroughly compacted, preferably a flat grade giving an increased thickness in the centre.

The materials should be carefully selected and the coarse aggregate should not exceed 1½ in., preferably smaller, and the sand should be a clean, well graded sand from ¼ in. down.

The mix should be carefully proportioned to obtain the maximum density and should be thoroughly turned in the machine for not less than 45 seconds and made wet enough to flow readily and not require tamping, or about as it would be mixed for reinforced work.

The surface should be rodded with a metal bound screed and floated with a wood float to a uniform surface, being careful to avoid slight depressions and irregularities which offer opportunity for steel-bound traffic to attack the surface.

After the pavement is laid it should be covered as soon as sufficiently set up, and kept well wet for a period of at least a week, preferably more. The wetting down is very important and should not be slighted.

A carefully and conscientiously constructed concrete pavement will, in the writer's opinion, give better return for the money expended than any other type, but he would emphasize the statement that every Tom, Dick, and Harry who have been building cement sidewalk, cannot be trusted to construct a satisfactory concrete pavement, and cement is one of the cheapest forms of insurance which can be placed upon such a pavement, but it must be thoroughly mixed with good tough aggregates and not slopped out before the ingredients have had time to be thoroughly spread through the batch. To this end, the manner of placing the materials in the hopper is of considerable moment, and should be given more attention than it ordinarily receives.

A tabulated recapitulation of expenditures, quantities, and unit costs, is given on the page following.

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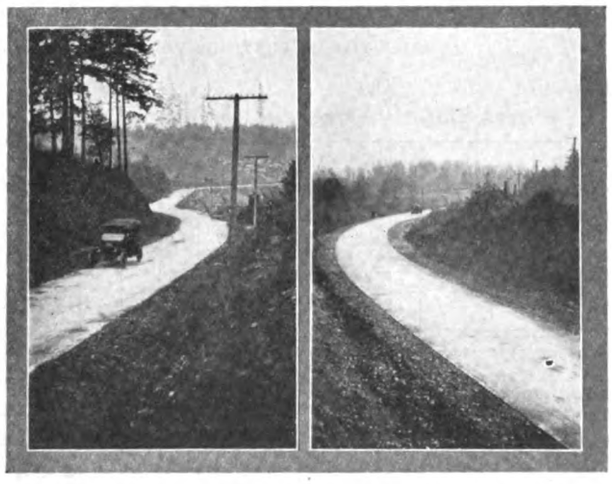

PUYALLUP BOULEVARD, CONCRETE 1-2-4 ROAD, 16 FT. WIDE, COST 82c. PER SQUARE YARD BUILT BY THE COUNTY.

Concrete Pavement	Labor.	Material	Total Cost.	Cost Per Amount	Amount Built
Sub Grade	$ 1066.42	$ 6.50	$ 1072.92	.03 per Sq Yd	34310 Sq Yds
Rolling	199.00			$7.80 per M	3/8 miles
Coal used		60.28	278.23		
Freight on same		18.95			
Sand & Gravel		372.75	444.29	.70 at spur	6350 Cu Yds
Freight on same		71.04			
Hauling sand & gravel	883.15	625.00			
Gasoline		24.79			
Lubricating Oils		15.03			
Crude Oil		367.20	226.87	393	Av. 4806 Ft
Coal used		16.00			
Freight on same		5.00		per mile	
Freight on equipment		39.10			
Drayage on crude Oil		293.00			
Unloading sand & gravel	155.52				
Derrick Constn & Maint'ce	31.32	692.58			
Coal used		76.28			
Freight on same		18.95			
Gasoline		12.39	274.91	.43 per Cu Yd	
Lubricating Oil		7.52			
Freight on Equipment		41.85			
Drayage " "		26.50			
Cement		1072.065	1072.065	per Bbl. per	Av. 4806 Ft
Hauling same	804.80		804.80	mile .145	6095 Bbl
Setting 3"x6" strips	84.72	54.23	696.95	per Linear Ft	length of road
Lumber		59.64	59.64	of road .036	13224 Ft
Concreting	248.53	64.45			
Creosoted strips		26.50			
Gasoline		49.58			
Drayage on mixer		21.00			
Lubricating Oil		7.53	318.045	per Sq Yd .092	34310 Sq Yds
Finishing	148.21			.0043	
Wetting down	22.121	89.71			
Gasoline used		61.98		.011	
Freight on equipment		3.75			
Tools & Supplies	35.66	758.58	794.24		
Warehouse	83.90	61.56	145.46		
Office Exp'se and Industrial Insurance	238.17	142.10	371.27		
Miscellaneous Drayage and Freights		303.30	303.30		
Total Concrete Pavement	$ 8672.61	$ 19215.97	$ 27888.58	per Sq Yd .813	34310 Sq Yds.

Portion of time only able to haul 1-6 Yd wagon owing to rainy weather and condition of road

This item is exceptionally high due to delays in receiving materials beyond our control and the conditions under which the work was done, also the entire use of engine for three months at $125.00 per mo. is included emphasizing the economy of owning equipment which could have been bought for $1200.00 and interest, and depreciation would not have been but a fraction of the rental.

Cost, $27888.58
Lowest Bid, $30192.80

The writer was in sole charge of the above work, and while it was a public force account job, there were absolutely no strings tied to him. He was given absolutely full and free authority to do whatever was required. M. Roy Thompson is County Engineer of Pierce county, and the writer is chief deputy on his staff, having particular charge of bridge and concrete construction. The Board of County Commissioners, who are making a record as broad-minded progressive business men, are: W. H. Reed, chairman, district No. 2; H. C. Martin, district No. 1; and G. H. Smith, district No. 3.

A Government Hydro-Electric Power System

By BARRY DIBBLE

To furnish power for pumping water to irrigate some 48,000 acres of bench lands in the Minidoka project, the Reclamation Service built a power plant at Minidoka dam, on Snake river, Idaho, a description of which appeared in the *Reclamation Record* as follows: With a fall of 46 ft., this plant develops approximately 10,000 hp., using water which must be allowed to flow down the river for prior rights.

Over 90% of this power is required for pumping during the height of the irrigation season, but during the winter the plant would be idle except for the extensive use of power in the towns and on the farms of the project. Here electricity is used for heating and cooking, as well as for lighting and power.

The Minidoka dam is 6½ miles south of Minidoka, Idaho, the nearest railroad point. The power house is at the north end of the dam, on the diversion channel, which is used for a tail-race. Water for running the plant is taken through 10-ft. penstocks directly from the reservoir, known as Lake Walcott, created by the dam.

The building is a two-story reinforced concrete structure, 50 by 150 ft., resting on piers in the diversion channel. On the first floor are five 2000-hp. vertical turbines connected to the penstocks. Directly above each turbine, on the second floor, is a 1200-kw. electric generator. On this floor also are the exciters and governors that control the turbines. The generators furnish current at 2200 volts, which is increased to 33,000 volts by air-cooled transformers located on a gallery overhanging the second floor. This gallery also contains the switchboard for controlling the entire power house.

From the power house transmission lines carry the energy over the project. The three principal pumping plants for supplying the South Side unit are from 11 to 13 miles from the power house. Some comparatively small irrigation pumps have also been installed for high-land areas on the north side of the river. A number of drainage pumps have been in use for several years to keep down the ground water until deep gravity drains could be completed.

Four substations supply power for use in the towns of Rupert, Heyburn and Burley and for groups of farmers. These towns are 13, 20, and 22 miles, respectively, from the power house. The transmission system consists of 62 miles of 33,000-volt lines and over 20 miles of 2200-volt lines.

The lands under the South Side unit are covered by three canals, at 30, 60, and 90-ft. levels. The water is lifted from stage to stage by the largest pumping stations which have ever been used for purposes of irri-

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gation. During the irrigation season of 1913 about 120,000 acre-feet were pumped, of which 17% was used on the 30-ft. level, 36% was used on the 60-ft. level, and 47% was pumped to the 90-ft. level.

The fact that this irrigation pumping uses nearly the entire capacity of the power house in the summer and leaves it idle in the winter, left an opening for a very interesting phase of development, of which advantage has been taken in supplying power to the three principal towns of the project and to the farmers and various industries. The probable demand would not have used more than a small portion of the power available for many years. The problem was to market the surplus during the winter. Electrical cooking and heating were encouraged by giving low rates, and the demand has grown rapidly. On January 1, 1913, the three towns of the project were served a maximum of nearly 1500 kw., an increase of nearly 100% over the amount used at the beginning of the preceding year. On January 1, 1914, this had practically doubled again, being close to 3000 kilowatts.

This use of power was so novel that at first suitable electric heaters could not be obtained, and the Government engineers were called upon to design and build them. Now heaters are shipped to the project in large quantities by several electrical firms. For the ordinary household use of electricity for lights, ironing, washing-machines, vacuum cleaners, and cook stoves, the energy costs from $3 to $4 per month, while to heat the same house it costs from $4 to $8 or $9 per month in the winter.

The Amalgamated Sugar Company uses over 200 kw. for motors in its factory at Burley. The alfalfa meal mill of the Portland Feeder Company, a new industry on the project, uses a 50-hp. motor. Here pulp and molasses from the sugar factory are mixed with alfalfa meal and ground grain to feed over 2000 cattle. At Heyburn a flour mill and brick-yard are electrically operated.

At Rupert a handsome three-story high school with accommodations for 600 students has just been completed. This building has no chimney. Its electric heating plant has a capacity of 400 kw. A blower delivers enough warmed air to fill the building every fifteen minutes. The domestic science room is equipped with individual electric hot-plates. The chemical laboratory has electric evaporating pans, water stills, and other appliances. The manual training shop apparatus is run by the motor which drives the main ventilating fan. Hot water for the gymnasium baths, domestic science department, chemical laboratories and other features, is provided by an electric water heater. The building is brilliantly lighted throughout.

Both Rupert and Burley have modern water systems, drawing water from deep wells by electrically operated pumps. Revenues from the sale of electric energy have increased very rapidly, amounting in 1910 to something over $500; in 1911 to over $5,000, and in 1913 to over $15,500.

The increase in the winter demand is shown by the variation in the power furnished by the plant since it began operations. The peaks or high points recur each irrigation season when almost the full capacity of the plant is utilized in pumping for irrigation.

The power system has been operated since 1909, when power was used for pumping only. In the fall of 1910 delivery for commercial purposes began. Three 8-hour shifts work at the power house and principal pumping stations. Operators are paid $75 to $85 per month, depending upon experience and responsibility. The power house is in charge of a foreman and an assistant. The three South Side pumping stations are in charge of one foreman, who also has an assistant. The transmission lines and 150-mile telephone system are patrolled and kept in repair by a foreman and lineman, who also look after considerable construction work. The smaller stations are usually taken care of by a single man at each who devotes only a part of his time to this work.

ERECTING 150-FOOT STACK WITH 10-FOOT GIN POLE

A steel smokestack 9 ft. diameter and 150 ft. high was recently erected in an unusually simple and expeditious manner by R. Dunseath, of New York city, for the Hugh Kelly Sugar Company, at its plant about 30 miles from San Domingo, West Indies. A scaffold consisting of four 3 by 3-in. braced vertical posts in 5-ft. lengths was built up inside the stack as each successive 5-ft. course of the steel shell was erected. The vertical posts were connected by horizontal 6 by 1-in. boards nailed on and were wedged against the shell but not cross-braced. At the top of each story a working platform of loose boards was laid and a 6 by 8-in. horizontal piece wedged and bolted securely in position to receive the foot of the gin pole. The gin pole was an 8 by 8-in. timber 10 ft. long fitted with a spider and guy lines and tackle connection at the top, and with a 1½-in. gudgeon pin at the bottom that engaged a hole in the foot block. It was so light that it was easily lifted by hand as the work advanced and the scaffold was built up to correspond.

All rivets were driven by hand, by four men. The cost per rivet was 4c. When not engaged in riveting, the men performed the work of assembling and scaffold building at a price of 75c. each per day of 10½ hours. Four more men were employed on the ground at a price of 65c. per day and the work was accomplished by this force in twenty-two days, although the estimated time required for the job was between three and four months.—*Engineering Record.*

A cement that will resist white heat may be made of pulverized fireclay, 4 parts; plumbago, 1 part; iron filings or borings free from oxide, 2 parts; peroxide of manganese, 1 part; borax, ½ part; and seasalt, ½ part. Mix these to a thick paste and use immediately. Heat gradually when first using.

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Estimating Productive Capacity of Oil Lands

By R. P. McLAUGHLIN*

Any reasonable venture in the oil business requires some notion as to the amount of oil to be taken from the ground. The question can never be definitely answered owing to the migratory nature of the substance in question as well as to the lack of information on the subject.

A common method of estimation has been based upon the thickness of sand in the property, assuming that 10% of the volume is filled with oil. This method has much to commend it from a theoretical standpoint and in fact appears most logical. However, it lacks proof from a practical view of California conditions, and unless further demonstrated can be of little use. A similar method if applied in estimating the metallic content of a vein would be based upon the measured width of vein and a theoretical assay value, which, of course, reduces the proposition to an absurdity. The view taken by the author is that no rule is justified unless supported by a mass of evidence in the shape of records of past performances of California oil properties, and the attempt has been made to present in this publication as much evidence as possible. The form of presentation is by diagrams and an explanation of one of them will bring out the very valuable features which might otherwise escape notice.

Taking for example the diagram marked 'Group B. Coalinga Field' which presents the actual history of a group of wells for six years. It will be noticed that there are three separate and distinct irregular lines upon the drawing. The left hand margin shows the three scales used in drawing the separate lines of the diagram. At the bottom is shown the time scale, divided by vertical lines into periods of three months. Total daily production as shown by the diagram is an accurate figure of the average amount of oil produced per day as shown by the total monthly shipments. The number of wells producing is fairly accurate, being taken from monthly field reports. Such reports are subject to some slight error due to the fact that idleness of a single well for a few hours, or days, is seldom noted.

Daily production per well is derived from the other two figures, the total daily production divided by the number of wells producing. As an illustration of the three scales, note the vertical line marked '5' which shows that during that month thirty wells produced a daily total of 2325 barrels or an average of about 78 barrels each.

As a whole, the curve shows that at the beginning of the record two wells were producing, and that others were drilled during the next three and a half years until thirty-six were completed, which, with the exception of two or three, have since continued to produce. During the first two years the total daily pro-

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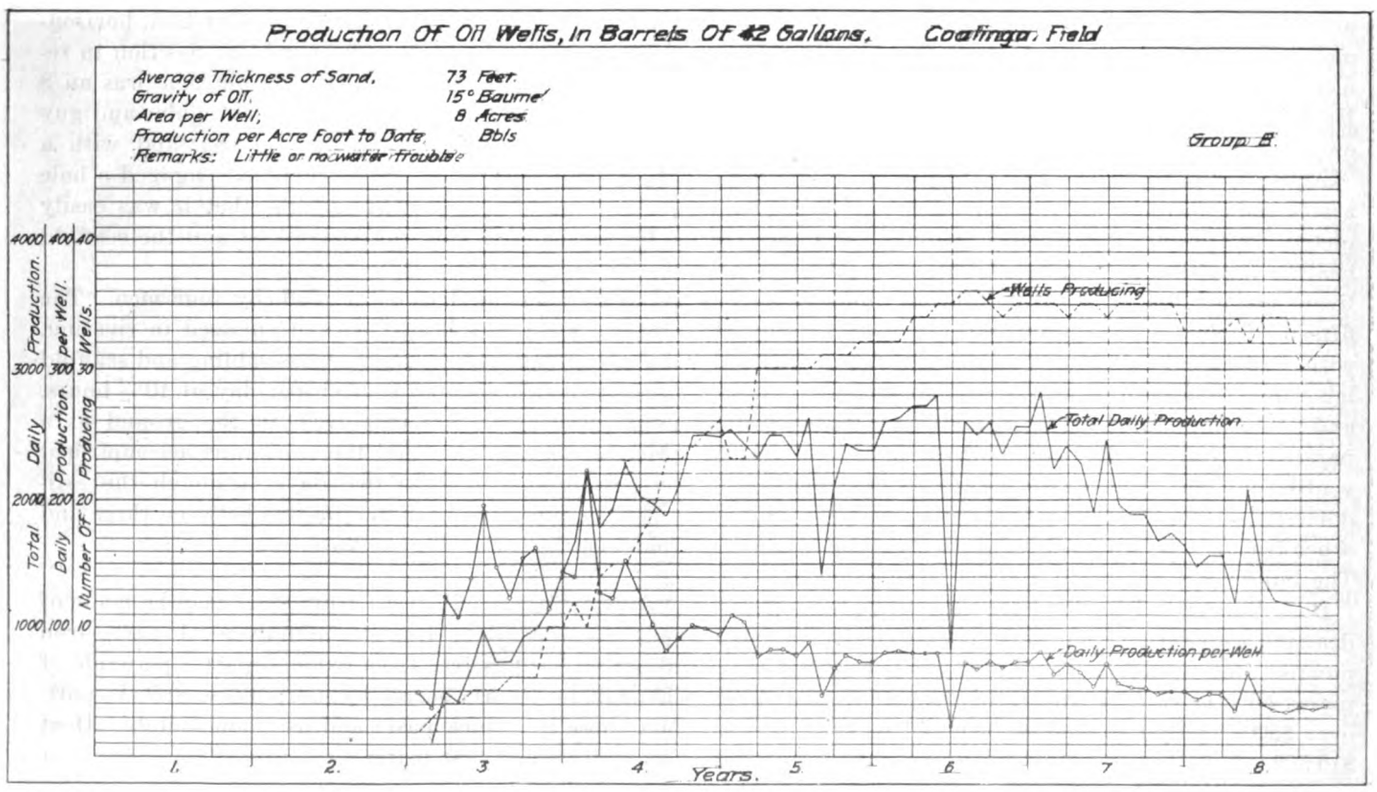

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duction rose from 100 barrels to 2500, was maintained for two years, and has since declined to 1200 barrels. During the first year, when from two to ten wells were producing, the average daily production per well was variable, probably due to unsettled conditions at the new wells. This is in a general way the history of an ordinary oil property.

The most striking and useful results are shown on the line for daily production per well. It will be noted that for the last four and a half years the average daily yield per well has gradually decreased from about 100 barrels to 40 barrels. The real usefulness of such a diagram on any particular property is that prediction of future production is not so hazardous as might otherwise appear. Extension of the daily well production line gives some reasonable idea of what the production may be at a future date of two or three years.

Upon nearly all the diagrams the daily well production line appears as a straight line, rather than a curve as has been frequently assumed. The first few wells drilled on a property are usually the largest producers and subsequent wells 'come in' at about the rate of those already producing.

Petroleum Investigations

By JOSEPH A. HOLMES

The U. S. Bureau of Mines investigations relating to the efficient production and utilization of petroleum and petroleum products includes the study of well-drilling methods, with especial reference to the prevention of waste of oil and gas at wells on or adjacent to public lands; the study of methods of storing and transporting oil and natural gas with a view to lessening loss in transit and in storage; the study of means for decreasing fires from lightning, which have caused heavy losses in the southern and middle western states; the study of refining methods in order to ascertain the best process of refining petroleum and improving the quality and increasing the yield of commercial products; and the study of fuel oils belonging to or intended for the Government, with especial reference to increasing efficiency and economy in their utilization.

Investigations of methods of drilling wells, and the various types of drilling rigs, tools, and appliances were continued in California, Oklahoma, Louisiana, Colorado, and Wyoming, and in other states. Methods used in the Oklahoma oilfields were studied in detail, and samples of oil were obtained from all the producing fields of the state.

In November, 1912, Ralph Arnold, petroleum engineer, visited the California oilfields in company with J. A. Pollard, consulting engineer, with the object of investigating methods of preventing the waste of oil and natural gas from flowing wells. Especial attention was given to the capping of gushers and gassers in the gusher territory of the Midway-Sunset fields. In December Mr. Arnold conducted a similar investigation in company with Mr. A. C. Mortenson, and in January made an extended trip in company with W. R. Calvert, consulting geologist, to investigate the prevention of waste and the most efficient methods of utilizing oil and gas in connection with topping and natural-gas gasoline plants.

The results of some of these investigations were published in a technical paper, and a description of the cementing process of excluding water from oil wells as practised in California, was published as another technical paper.

In the latter part of the fiscal year a study of the different methods used at oil wells in California for recovering oil was made, and the results were prepared for publication.

The bureau has made a careful examination of the conditions attending the development of oil and gas pools in Oklahoma, many of which are in Indian lands, in the endeavor to ascertain the wastes of oil and gas under the existing methods of drilling wells and of transporting and utilizing gas and oil, and to discover means whereby such waste could be prevented without hardship to the operator and to the advantage of the public. To ascertain the conditions that have led to enormous waste of natural gas in Kansas and Oklahoma, L. S. Blatchley, consulting geologist, visited the principal oil pools in those states. He found that not only had little effort been made to save gas (casing-head and flow-tank gas) at many oil wells, but that gas wells had been allowed to blow into the air daily millions of cubic feet of this ideal natural fuel. He also found that there had been great waste in the utilization of gas, chiefly through using it for purposes for which it should not be used, or selling it at prices that discouraged economy in its use. Mr. Blatchley also found that there had been much waste of petroleum in the form of sludge and residue from oil tanks. His findings are being prepared for publication as a technical paper.

As a result of its investigations in California and Oklahoma the bureau ascertained the feasibility of drilling oil wells in Oklahoma by means of cable tools and the use of mud-ladened water to plaster the sides of the wells, and thus prevent the escape of gas from sands overlying the oil sand. Having ascertained the practicability of the method, the bureau had one of its petroleum engineers, J. M. Pollard, demonstrate the ease with which wells could be drilled and waste of oil and gas prevented when the method was usd. Already the waste of millions of feet of gas has been stopped and the life of the Cushing gas field has been prolonged. Further work will probably demonstrate the value of the gas in this field.

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Irrigating Plant for 625 Acres

By E. R. FEICHT*

We have all seen interesting and instructive descriptions of the methods used in irrigating 10 to 200,000 acres, both on private and government irrigation projects; we know something of the source of supply and the means used in handling and distributing the water. We also have an idea of what we can do when we have 3 to 5 acres to irrigate, but suppose we wish to irrigate 600 to 1000 acres and have no streams or other easily available source of water supply. This problem has not been dealt with so frequently, lying as it does in the hazy middle ground where methods have not crystallized to standards. The irrigation plant built by the Sacramento Valley Sugar Co. on its Wilson ranch near Nord, Butte county, California, may prove of interest, as being one designed to take care of 625 acres of sugar beets and a possible ultimate capacity of 1200 acres.

That portion of the ranch to be irrigated lies 3 miles north of Nord on the Southern Pacific railroad at Anita spur and about 3 miles from the Sacramento river. The soil is a rather heavy adobe at the northern end of the piece, getting lighter toward the southern end. The land has a good slope from north to south, but from west to east it is much more gradual. The land is badly cut up by sloughs and channels, and by flooded waters from Pine creek, all of which run from north to south, with a slight easterly trend. Pine creek is a wet-weather stream, coming up very rapidly after rains, but dry when the land must be irrigated, and so is not available as a source of water supply.

The writer had already designed and installed a number of successful 'well plants' in Yolo and Butte counties for the Company, and it was decided to try out a 'well system' on this ranch, although there were no irrigation wells in the vicinity which could forecast the success of such a plant. A plant furnishing 4000 to 4500 g.p.m. would, if operated from daylight to dark, 15 to 17 hours daily, furnish sufficient water for 625 acres.

This called for a 12-in. pump, and, as a first estimate, six 12-in. wells. The plant is at the highest point along the north line of the property 2900 ft. from the railroad. The wells are spaced 30 ft. apart, parallel to the property line and 10 ft. from it. In general, the plant as designed consists of a 12-in. horizontal centrifugal pump, belted to a motor and connected to the wells by a horizontal suction header. The pump discharged into a concrete pipe-line running along the north property line to the railroad on the east, whence the water is carried by ditch. The wells were all 12-in. diameter and cased to within 1 or 2 ft. of the bottom of the gravel strata with No. 14 hard, red, double stove-pipe casing. Each string of casing began with a 6-ft. 'starting column,' the same being a section built up of separate joints riveted together and shod with a ½ by 4-in. steel shoe. The casing for these wells is in 24-in. joints, which most drillers using hand or half-hand half-power rigs seem to prefer. The casing does not, as may be supposed from the name, drive together like stove-pipe, but is built up of an inner and outer joint, the outer joint lapping half way up the inner. In driving the casing, as each piece is put on, it is riveted by four small rivets, forming when completed a continuous built-up pipe, not in any manner water-tight however.

The six wells were put down by means of a combination hand and power rig, in which the more laborious part of the work, sand pumping, and raising tools, was performed by a small gas-engine and winch. The rig itself was very simple, consisting of a sort of light tripod with single sheave at the top. The winch was erected on the back of a wagon, to which two legs of the tripod were fastened. The tools themselves consisted of the usual jointed rods, mostly about 20 ft. long, with the necessary sand buckets for working in gravel and earth augers for clay and soil. The casing was forced by means of a lever 20 ft. long, held at the well end by a 'dead-man' buried beside the well and loaded at the far end with six sacks of gravel and in tight places by all the operators and even spectators who could be persuaded to add their mite. The outer end of this lever was handled by a tripod and windlass and the well end by the gasoline winch.

A log of each well was kept as it was drilled, and it is interesting to note the similarity of the logs of the different wells. When the first gravel bed was found to be 40 ft. thick, it was decided that it might reasonably be expected that sufficient water would be gotten from six wells to furnish the required amount, but for general information regarding the water-supply for future work, it was decided to drill one well to second gravel. This well, known as well No. 2, was drilled to 84 ft. and there struck a hard formation that the driller was unable to penetrate, and the attempt to test for second gravel was abandoned for the time.

The wells were all cased as fast as drilled, the casing never being more than 4 or 5 ft. from the bottom of the hole and more generally less, except possibly while going through clay, when sometimes the casing did not follow so closely. However, the best way is to have the casing follow just as near to the end of the hole as may be possible, as this practice helps to keep the hole straight.

There is a tendency, in territory where irrigation from wells is just coming into vogue, for drillers who

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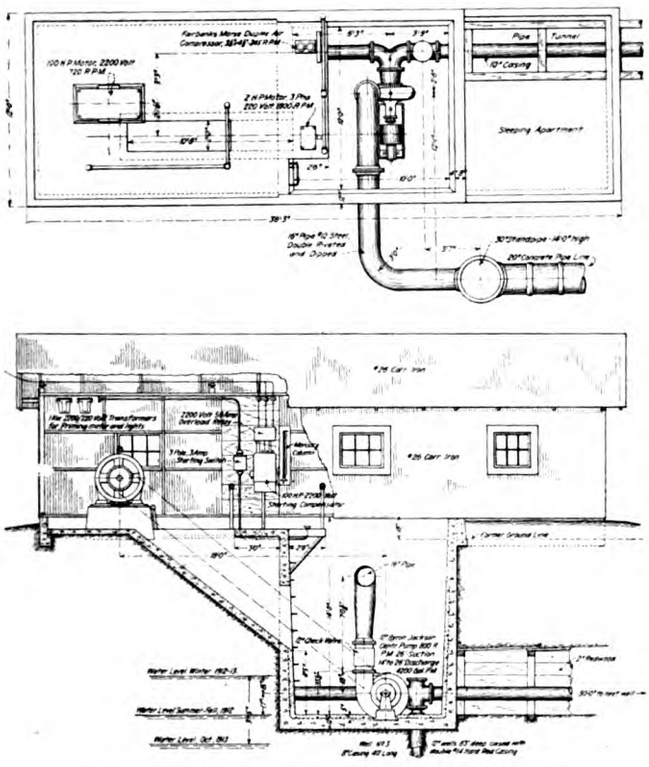
have been accustomed to putting down holes in the ground for stock and house wells, to use the same methods in putting in irrigation wells. They only case their wells down 20 or 30 ft. and run an 'open hole' the balance of the way, be it through clay or gravel, claiming that the hole will stand. Now it may in clay, and perhaps in gravel if the gravel is tight and compact and has little water in it, or is called upon to furnish but little water; but that is not an irrigation well. The owner of an irrigation well wants every drop of water that can be gotten out of it, and when a pump is put on the well, just as surely as the gravel carries the amount of water desired, then just so surely will the well cave in when the pump is started. That has been the experience



ELEVATION AND PLAN OF TYPICAL PUMPING PLANT.

of a number of the unwary, who have had wells put down in this vicinity.

Another point that has been brought out in the experience of the Company is that casing should, in all cases of gravels containing pieces up to 2 in. or larger, be driven only to within about 1 ft. of the bottom of the gravel strata. This also is a point that it is difficult to make the average driller see; for if he must case the well to keep it from caving, why not seal it off in the clay below the gravel? There are two reasons for this: the first being that the bottom of the casing is left open for the free entrance of the water and dependance is not made upon perforations only; the second reason is that we desire the gravel to cave —yes, we desire the gravel to cave; but to cave more or less under our control. When the pump is started on a new well of this type, the first result is muddy sandy water, even a gravelly water, which continues for some time, as the sand and lighter particles are washed from among the larger stones, leaving a percolating area for the water very much larger than could be obtained in any other manner and resulting in an increased flow from the well. Of course, the well fills up 5, 10, even 15 ft. with the coarser particles of gravel, which must be pumped out at the end of the season or perhaps once during the first season, but this expense is slight for the results obtained, if the piping is put in with the necessity for sand pumping in mind. If the larger rocks are not brought by the water to the end of the casing and finally stop the filling of the well, nature can be assisted by a few well chosen rocks from above dropped into the well. This, however, has never been necessary in the forty or so irrigation wells put down by the sugar company during the past three years.

In the Wilson Ranch plant the first six wells are spaced 30 ft. apart, with pits going down to the ground-water surface at wells No. 1, 3, and 6. The pits at well No. 1 and 6 were for access to the suction pipe, after the concrete pump pit at well No. 3 was completed. All construction work was done from the pump pit at well No. 3.

The Company not being in the contracting business, and only putting in a plant now and then as called for at the moment, no special equipment for this construction work was purchased or built that could possibly be avoided; only the simplest of apparatus being used and no special investment made for material or apparatus that would be of use on this particular plant only. This, however, will generally be the case of a plant of this size: it will be built by the owner, who will want as little material left on his hands at the completion of the job as possible. This requires methods and apparatus which would be very crude for a contractor doing this or similar work.

In order to get full benefit of the draw down of the wells, and consequently the greatest amount of water possible, it was necessary to place the pump as low as possible and as close to the water-surface of the wells as could be. The water-level in the ground at the end of the summer, when the work of the plant was commenced, was 12 ft. below the surface of the ground. The pits and tunnels were, therefore, dug with their floors at that level, the idea being further to excavate the main pit after the tunnels were dug, so that the top of the concrete floor should be at the water-surface, and then to place the base of the pump 7 in. below the main floor.

The work went on with these ends in view, the pit being dug and the material handled entirely by hand, being thrown out with one handling, as far as this could be done, and later thrown on to a simple staging, whence it was thrown to the surface. The pit was dug 11 by 12 ft. and 12 ft. deep, the sides trimmed smooth, so as to require no lumber for forms on the outside. This could be done, as the material excavated was of a character that did not cave easily.

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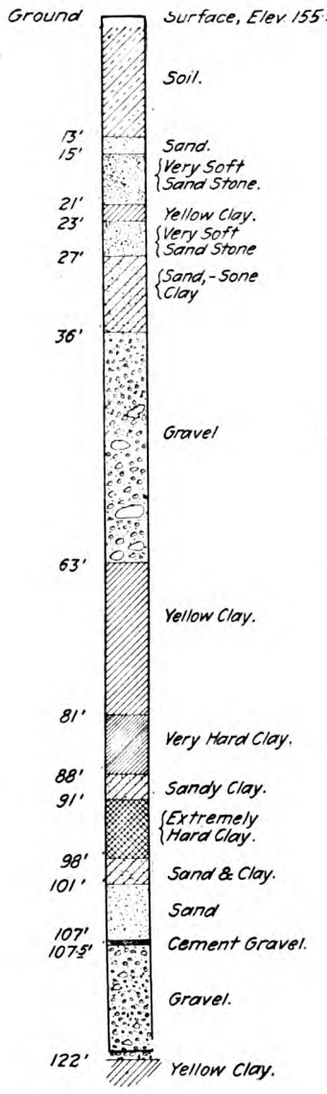
Later when the rains set in, a little trouble was caused by the upper edges caving off, but this caused little inconvenience.

On completion of the pit, tunnels 4 ft. 3 in. wide at the bottom, 3 ft. 4 in. wide at the top, and 4 ft. 6 in. high were started. These dimensions were chosen so that after the tunnel timbering was in place a wheelbarrow on a small car could be pushed through the tunnel and have ample clearance. This also was about as small as was convenient for the installation of the



WELL No. 8, ON WILSON RANCH.

suction piping. The car was roughly built, as its use was temporary. The wheels, such as are found on the fruit-rack cars in fruit-drying yards, about 8 in. diameter, were mounted on 1-in. pipe axles. The wheelbarrow was lowered upon the car and pushed into the tunnel over rails of 2 by 4 to the face of the drift and there filled and run back to the main pit. Here an iron ring on the end of a short chain was slipped over each handle and a third chain hooked into the wheel. Two strokes on an old plowshare gave the signal for the hoist to operate. It is remarkable to note how quickly motive power learned the signal and operated almost automatically, the motive power being a superannuated mule. The hoist was of the simplest construction: a frame like an enlarged carpenter's 'horse' spanning the pit with a pulley fastened to the top, with the rope through it running to a snatch-block at one side and thence to the motive power. The man at the top of the pit unhooked the wheelbarrow, pushed it forward, hooked up an empty barrow, and, while it was being filled, wheeled the spoil out to make a fill for the pump-house. The fill was necessary to provide a place for the motor above high-water mark.

The tunnel work was carried forward both east and west at the same time with a crew comprised of the following: one man digging at each face, one man in each tunnel loading and pushing the wheelbarrow to the hoist, one man unhooking the barrow and carrying away the spoil, the 'mule boy,' and a working foreman. The foreman, who was a carpenter, framed the timbers, helped out above or below ground whenever needed, and kept the work going. This crew would average 7 to 9 ft. of tunnel each way per day, handling about 6 cu. yd. of material, at a cost, including their meals at 15c., of $1.40 per foot of tunnel excavated. When about 30 ft. of tunnel had been dug, a week of rain came on, resulting in a 2½ ft. rise of the water table. This proved a serious annoyance and hindrance to the work, inasmuch as it required a gas-engine and pump to keep the water out of the workings, and the delays caused by both the engine and the pump were most discouraging, taken together with the fact that on account of the water and mud in the tunnels the men could not work to advantage. Not only that, but the cost of a gas-engine operator, and the cost of oils and distillate, added seriously to the cost of tunneling and all subsequent work of timbering, concreting, setting the pump and putting up the piping.

At the commencement of tunnel work, it was expected that the timbering would have to follow along with the digging, as had been required on several earlier plants, but fortunately this was not required here, as the ground stood well. The 2 by 10 redwood lining was therefore put in in 16-ft. sections, thereby cutting down the expense a little.

When the tunnels were finished the main pit was concrete, openings being left the size of the finished tunnels in each side for the installation of the suction pipe. These openings were concreted in when the piping was all in place. The slough to the east of well No. 1, with very little trenching, permitted taking the suction pipe into the tunnel at that end. All the horizontal run was put in at this end and carried on the dirt car to its approximate position. The vertical suctions into each well were lowered through the upper section of the well casing, which remained in place from the top of the tunnel up. These suction legs, made up of two stock joints from 19 to 21 ft. long, were handled in two pieces: the first joint lowered into the well and held by a wooden clamp in the

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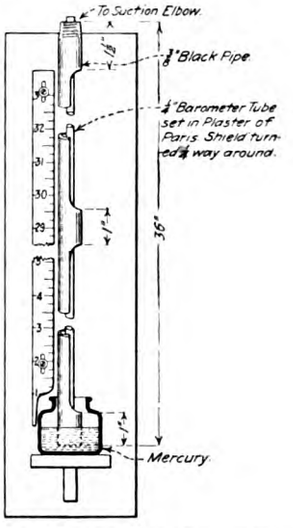
tunnel; the upper section was lowered upon it, screwed up, the whole lowered into place, and the flange screwed to the upper end. This made unnecessary the use of a high derrick, a tripod of three pieces, 4 by 6 in. by 18 ft., being used in handling the pipe, a crew of five men doing the work.

These suction legs were somewhat longer than is generally used, but can be objected to only on the score of added friction, and this is immaterial, as they were so large that 5 or 10 ft. adds very little to the friction head on the pump. They were of this length as it was found previously that when wells are being pumped down to their limit there was a tendency to create a swirl, which drew air into the suction and interfered with the vacuum maintained.

A further reason, independent of friction considerations, for making the well suctions 7⅝ in. inside, was to permit sand-pumping the wells without removing the suction pipe; a sand pump of 6 in. outside



WILSON RANCH VACUUM GAUGE.

diameter going down through the suction without difficulty. As a further convenience in sand-pumping, the fittings over the wells were flanged crosses instead of Ts, so that, in order to sand pump, it is only necessary to set up the tripod over the well, remove a blank flange, and go to work. The cost of sand-pumping under such conditions has been $25 per well. Sand-pumping has been found advisable but once in the season, and not absolutely necessary then, although there may be as much as 10 ft. of gravel in the bottom of the wells. The wells of this plant have not as yet been sand-pumped.

The pump, a 12-in. Byron Jackson, belted, non-overloading, enclosed runner, horizontal centrifugal, running at 800 r.p.m., delivers water with a total lift of from 38 to 50 ft., depending on where the water is discharged, into the ditches; being a minimum when discharging into the ditch at the plant and a maximum when discharging into a ditch at the end of 2900 ft. of 20-in. concrete pipe.

A number of reasons resulted in the selection of a belted rather than a direct-connected unit. It was not felt advisable to go to extra expense to make the concrete pit absolutely waterproof, and unless it were so the motor would have to be removed at the end of each irrigation season. Even with a tight pit the motor would have to be removed; for the land on which the plant is situated is subject to overflow and the pit might be flooded during the winter. The belted connection permitted the use of a motor whose speed and voltage were such that it could be interchanged with other large motors in the Company's other irrigation plants, near Hamilton and in the factory at Hamilton. The possibility of changing the pump speed, if that should prove necessary, was also considered.

The motor—General Electric Co. 3-phase, 100-hp., 2200-volt—was placed on a concrete foundation about 1 ft. higher than any recorded high water. The starting compensator was equipped with both no-voltage release and overload relay, and all wiring for main and priming pump motors and lights was in conduits. The belt, a 14-in., 8-ply Ruboil, was run on 23 ft. 6-in. centres, 18 ft. centres horizontally, with a rise of 14 ft. 6 in. that distance.

A 12-in. vertical check valve was placed on the outlet of the pump, and from it the discharge, a double riveted and dipped 14-in., 12-gauge pipe with large radius bends, carried the water to the stand-pipe at the head of the concrete pipe-line.

The air was exhausted from the suction line by a 3¼ by 4½-in. duplex single-acting Fairbanks-Morse air-compressor with its suction pipe to the suction Y of the pump. By starting the main pump about five minutes after the compressor, a full head of water was delivered in seven minutes at the latter part of the season when the water table had receded to about 6 ft. below the pump. With the priming line on the pump suction the pump assisted materially in priming itself, throwing out large charges of air, as soon as the suction pipe became about half full of water. The priming pump ran at 250 r.p.m. and was belted to a 1200-r.p.m., 220-volt, 3-phase Westinghouse motor.

The vaccum gauge was made up of a 36-in. piece of barometer tubing set in plaster of paris in an equal length of ⅜-in. pipe, which had been cut to serve as a shield for the tube as in sketch. The whole was set in a small bottle of mercury and with a yardstick formed a most satisfactory gauge, never out of order and always accurate.

The priming and main motor-starting switches and vacuum gauge were all mounted on a switchboard so as to be most convenient for the operator. Standing before the board, he has an unobstructed view of his pumps, motors, and vacuum gauge and the control of all of these under his hand. Next to the switchboard is the tool-board, with all necessary wrenches and tools thereon. The pump-house, 38 by 12 ft. 6 in., was built of galvanized corrugated iron, amply provided with lights and windows and with one end partitioned off for the sleeping quarters of the pump-man.

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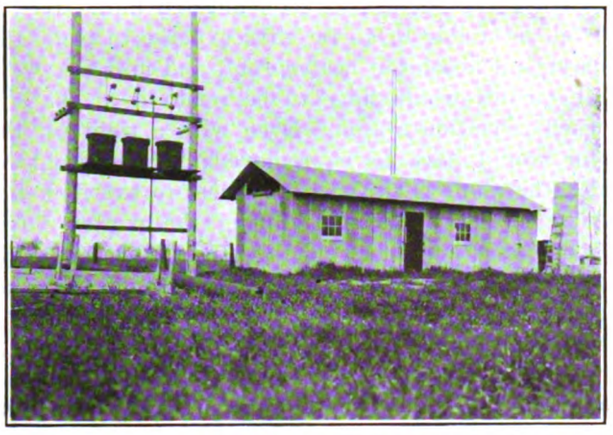


EXTERIOR OF PUMPING PLANT, SHOWING TRANSFORMERS.

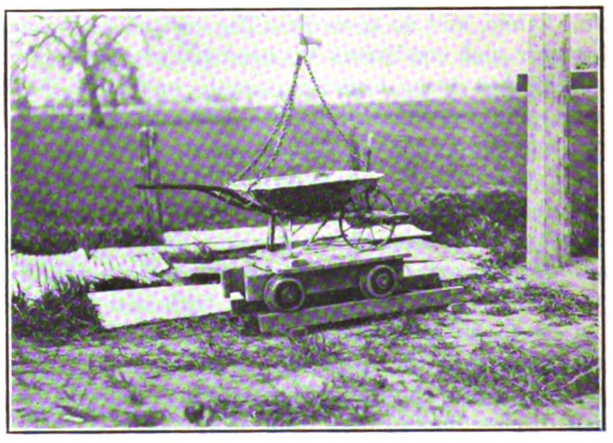
The plant was generally operated for 24 hours per day with but one operator, he setting his alarm clock when he turned in of an evening, to wake him every 2½ hours, when he saw to the oil for the pump and went back to bed. He soon became used to this broken rest and did not find it burdensome. He got his meals at a neighboring ranch house, about a quarter of a mile distant, so no provision was made for cooking at the plant. A branch of the Company's private telephone system placed him in touch with the Company's camp, two miles distant, and with the irrigation engineer at Hamilton.

When the plant was started it was found necessary to block off the suction to well No. 3 on account of the air which came in through the short suction. It will be remembered that this well was very shallow, the driller being unable to complete it because of a boulder struck at 42 ft. A test of the plant with the five remaining wells showed a capacity of but 3000 g.p.m., and it was decided to put down two additional wells. Work was started on these wells in June, by a driller using a strictly hand rig. Well No. 7 was put down into the same gravel strata and was of the same depth as the preceding wells. The new wells were placed, however, 50 ft. apart instead of 30 ft., which was the spacing of the previous wells. This was with the idea of getting away from the influence of the old wells and making the cone of depression of the water larger. It was decided to try for second gravel with well No. 8, and this was struck at 107½ ft., continuing to 122 ft. When struck, the water rose 11 ft. in the well, or approximately the amount the water in the first stratum was drawn down in this well when the pump was in operation, well No. 6 being 100 ft. away and the water lowered in it about 21 ft. from the surface. This well was perforated in both gravel strata. It is interesting to note in connection with this well that, after the irrigation season was well past and the rains had come on, causing the water table to rise, the water flowed from this well into the tunnel and thence into well No. 7, where it was carried to the upper strata of gravel. Besides this amount, there must have been a large quantity flowing from well No. 8 through its own perforation into the upper gravel strata.

A test of the plant with the seven wells connected showed a capacity of 4200 g.p.m., with a suction lift of 24¾ ft. and a discharge of 14 ft. At this time the input to the motor was 71.2 hp. The maximum horse-power input was when pumping all the water through the concrete pipe-line into the main ditch on the east property line. This was 75.2 horse-power.

The total cost of the plant exclusive of pipe-line and 4½ miles of 11,000-volt power line and its transformers to 2200 volts, was $8525. This is $1200 to $1500 more than the plant would have cost had it been built before the rains came on. However, taking this cost as a basis, and allowing 17% for depreciation, maintenance, taxes, and interest, and assuming the cost of power to be 1½c. per kilowatt, cost of packing and oils, practically the only other supplies, 75c. per week; the cost of the operator $90 per month when operating 24 hours per day, and $75 when running 14 hours; then the cost of water, considering the operating season as being four months long and operating each day from sunup to sundown, say 14 hours, then the total cost of delivering water per hour amounts to practically $1.90, of which by far the largest single item is the investment cost, 91c. The strictly operating cost is, therefore, $1 per hour. The daily cost is $26.50 per 14 hours. In other words, this means that it costs $6.39 to pump 1000 gal. per minute continuously for the day of 10 hours.

Judging from this plant, as well as from some others in the valley, it would seem advisable in territories with similar water strata and gravels to arrange the wells somewhat differently than was done on this plant. The wells should be spaced 30 to 50 ft. apart and well No. 1 driven to second gravel and only perforated in this lower stratum, well No. 2 to the first stratum only, well No. 3 to the second stratum, and so on, each well being perforated in but one stratum. The construction would take of the water in each stratum to the best advantage, and obviate any leakage from the second into the first.



TUNNEL CAR WITH DUMPING SLING.

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Street Improvements, Oakland, California

The policy of the Department is to pave the business district, gradually to extend the area outward in a logical growth as business and traffic require, and to pave the main highways leading to outlying sections or to neighboring municipalities. The Department plans to lay only the highest type of pavement adapted to the traffic requirements of the street. With few exceptions, the standard sheet asphalt has been used. This consists of a concrete foundation 6 in. deep, having a 1½-in. asphalt wearing surface laid on a 2-in. binder course of asphaltic concrete. This pavement will sustain the heaviest loads, even bridging over soft spots in the ground, can be torn up for pipes and replaced without damage, and its surface can be restored where worn at a minimum expense for patching. The only objection to this pavement is its slipperyness during a fog or light rain, but this difficulty has been largely eliminated throughout the hand-swept district by placing dry sand in suitable receptacles, to be applied by the street sweepers as needed.

It has been frequently proposed that we adopt a foundation and wearing surface of less thickness for use in residence streets, but in view of the heavy loads that are being carried by material teams and motor trucks, this proposal has been discouraged.

Brick has not been a success in Oakland, for the reason that the price is nearly double that of asphalt pavement, whereas its real value is generally conceded to be less. Basalt blocks make a noisy pavement, frequently, becoming rough, and are expensive. We have laid one short stretch of about 500 ft. this year, where the grade is too steep for asphalt.

Four and three hundred and sixty thousandths miles of permanent pavement were completed during the past fiscal year. This includes Telegraph avenue, between Fortieth and Fifty-second streets, Twelfth street and Fourteenth street, westward to Market street, Thirteenth street eastward to Fallon street, the resurfacing of the Hassam pavement on the Twelfth street dam with asphaltic macadam, and the paving of a number of short connecting links between portions of pavement already laid.

We have under way the paving of Thirteenth street from Clay to Market streets, and the following important highways: Grove street from Fortieth street to the Berkeley line, Broadway from Thirty-fourth street to College avenue, Sixteenth street from Peralta to Wood street, and Grand avenue from Harrison boulevard to Cove avenue. All of these, aggregating 4 miles, will be completed before the end of 1913.

For residence streets, we are using exclusively some type of oil-macadam. The oil-macadam heretofore generally used consists of the ordinary amount of macadam rock (6 in. deep at the gutter and 8 in. deep at the crown, measured before rolling) compacted and treated with two applications of heavy road oil, aggregating 1½ gallons to the square yard. The amount of oil is sufficient to produce an oil-bound surface of about 3 in. in depth. This type of pavement requires careful workmanship, particularly in the matter of securing a pavement firm enough to carry heavy loads and at the same time sufficiently porous to admit the oil. With the widely differing character of the stone in common use, the daily changing weather conditions and the disagreement among experts as to the proper method of building oil-macadam streets, this attempt to build a two-course macadam in one operation has been a serious problem to the Department. Results have generally been good, in many cases ideal, and in a few cases defects have developed. These defects, the excessively careful workmanship required to secure the best results with a single layer of rock, and the steady increase in the number of heavy auto trucks and material wagons have led to the adoption this year of specifications for a two-course oil-macadam on several of the more important streets. This work is now under way. This pavement consists of a layer of 4 or 5 in. of rock (it may be of poorer grade than otherwise required) consolidated thoroughly as water-bound macadam, and covered with about 3 in. of high-grade rock treated with oil.

Enough of this work has been done in Oakland and other cities to make it clear that this type of macadam is far smoother, stronger and more desirable than any single-course macadam can be. And it is believed that the use of a cheaper rock in the base, and the general simplification of the workmanship, will keep the price down to a point very close to that of single-course work.

The use of oil-macadam has been forced upon us by the heavy increase in auto vehicles. Water-bound macadam will not stand, even with the best of maintenance, under rapid-moving rubber tires. These actually kick the small stones and dust off the surface of the street, destroying the bond and causing the road to ravel and become rough and full of holes. Therefore, we not only build no more water-bound macadam streets, but are treating those already constructed with oil or tar. As already indicated, over 40 miles of old streets have been so treated by the Department during the past year, and since July 1, 1911, we have reduced the amount of water-bound surface from 254 to 192 miles. Fortunately, this enforced use of oil has its compensations, for it has cut our sprinkling bills enormously, reduced the cost of repairs and enabled us to give better service on the remaining water-bound macadam.

Generally speaking, the new construction of oil-macadam has been at the request of the owners of a majority of the frontage, or in new tracts being opened for subdivision.

*Abstract from Annual Report by Wm. T. Baccus, Commissioner of Streets.

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The tables summarize the construction operations for the past fiscal year. Table 1 gives the approximate quantity of the various units of construction, together with the maximum, minimum and average contract prices. This table omits a number of small miscellaneous items, as well as several larger items that are incapable of being divided into convenient units, but covers quite completely the ordinary construction work of the Department. The list of unit prices is included in this table as a matter of general interest, although it is clear from the wide range of prices that it has little real value. Conditions that affect price, such as specifications, construction difficulties, haul of materials, legal proceedings, and terms of payment, differ so widely from job to job that a table of unit prices must be used with extreme caution.

TABLE 1

APPROXIMATE QUANTITIES AND PRICES OF CONSTRUCTION UNITS

	Quantities.	Prices per unit ($) Max.	Min.	Mean.
Permanent Pavement.				
Grading, sq. ft.	867,867	0.035	0.01	0.024
Asphalt paving, sq. ft.	762,357	0.24	0.18	0.201
Basalt block paving, sq. ft.	13,952	...	....	0.440
Granite curb, lin. ft.	20,345	1.51	1.23	1.358
Concrete curb (protected) lin. ft.	16,626	0.86	0.55	0.692
Concrete gutter, sq. ft.	17,198	0.18	0.13	0.148
Basalt block gutter, sq. ft.	46,185	0.46	0.40	0.442
Brick gutter, sq. ft.	30,676	0.42	0.36	0.404
Macadam.				
Grading, cu. yd.	272,910	0.85	0.20	0.402
Grading, sq. ft.	285,491	0.05	0.01	0.017
Oil-macadam (one course) sq. ft.	2,581,486	0.10	0.0775	0.085
Redwood curb, lin. ft.	146,472	0.14	0.10	0.110
Concrete curb, lin. ft.	63,360	0.50	0.25	0.410
Broken rock gutter, sq. ft.	108,308	0.14	0.10	0.118
Concrete gutter, sq. ft.	448,745	0.15	0.11	0.134
Corrugated iron culverts, lin. ft.	6,084	3.00	1.50	2.58
Sewers.				
6 in. sewer (pipe), lin. ft.	8,730	1.00	0.46	0.620
8 in. sewer, lin. ft.	366,647	1.57	0.48	0.715
10 in. sewer, lin. ft.	34,618	1.75	0.625	0.963
12 in. sewer, lin. ft.	17,313	1.90	0.80	1.179
14 in. sewer, lin. ft.	9,513	2.00	0.95	1.295
16 in. sewer, lin. ft.	16,219	2.50	1.15	1.534
18 in. (double strength) lin. ft.	6,636	1.75	1.55	1.642
21 in. (double strength) lin. ft.	7,298	2.95	1.90	2.136
24 in. (double strength) lin. ft.	5,659	3.00	2.20	2.400
30 in. (concrete) lin. ft.	4,742	2.60	2.05	2.273
33 in. (concrete) lin. ft.	2,121	....	....	2.60
36 in. (concrete) lin. ft.	4,986	2.65	2.50	2.560
39 in. (concrete) lin. ft.	2,191	....	....	2.70
Catch basins	66	75.00	30.00	38.50
Inlets	44	50.00	15.00	22.86
Conduit (10" to 14") lin. ft.	3,332	2.50	0.50	0.707
Drop connections	79	10.00	4.00	5.71
"Y" branches (on 6" to 24")	24,028	3.00	....	0.760
Manholes	944	72.00	30.00	42.40
Lampholes	564	15.00	5.00	10.49
Concrete (in storm sewers) cu. yd.	5,554	10.00	6.81	7.29
Sidewalks.				
Cement sidewalks, sq. ft.	760,266	0.22	0.08	0.1088

Table 2 is a summary of street construction for the entire fiscal year. It will be noted that the greater

TABLE 2

STREET WORK CONSTRUCTION FISCAL YEAR 1912-1913

	Length (miles.)	Estimated cost.
Permanent pavement—		
July-December, 1912	2.767	$ 267,839.77
January-June, 1913	1.593	107,166.27
Total	4.360	$ 375,006.04
Oil-macadam (including grading, curbing, etc.)—		
July-December, 1912 (contract)	14.484	$ 445,848.90
January-June, 1913 (contract)	2.475	87,656.11
July-December, 1912 (by Dept.)	2.165	.....
January-June, 1913 (by Dept.)	0.578	.....
Total	19.702	$ 533,505.01
Sanitary Sewers—		
July-December, 1912	75.715	$ 445,937.17
January-June, 1913	16.467	95,998.75
Total	92.182	$ 541,935.92
Culverts, Storm Sewers, etc.—		
July-December, 1912	2.095	$ 52,560.94
January-June, 1913	0.088	1,465.25
Total	2.183	$ 54,026.19
Sidewalks—		
July-December, 1912	17.057	$ 59,275.36
January-June, 1913	7.585	26,292.07
Total	24.642	$ 85,567.43
Miscellaneous		$ 6,575.53
Total cost		$1,596,616.12

TABLE 3

STREET MILEAGE FOR FISCAL YEAR ENDED JUNE 30, 1913

(Figures in Miles of Length)

	July 1 1912.	Increase during yr.	June 30 1913.
Standard asphalt	20.103	4.056	24.159
Bitumen	6.184	— 0.197	5.987
Asphaltic concrete	1.240	....	1.240
Asphaltic concrete on cement, concrete base	0.137	0.211	0.348
Hassam concrete	0.211	— 0.211	....
Wooden blocks	0.410	....	0.410
Basalt blocks	0.057	0.093	0.150
Vitrified brick	0.129	....	0.129
Oil-macadam	17.654	19.702	37.356
Water-bound macadam	236.637	—44.526	192.111
Water-bound macadam, oil surface	28.946	19.657	48.603
Water-bound macadam, tar surface	.....	17.970	17.970
Turnpike roads, macadamized.	61.500	— 4.39	57.110
Turnpike roads, oiled	4.053	2.679	6.732
Unimproved	142.695	....	132.581
Total dedicated streets	519.956	4.930	524.668
SUMMARY			
Hard pavements	28.471	3.952	32.423
Macadam	283.237	12.803	296.040
Partially improved	65.553	— 1.711	63.842
Unimproved	142.695	....	132.581
Total street mileage	519.956	4.930	524.886
Sewers	287.960	94.365	382.325
Sidewalks	624.355	24.642	648.997

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part of the work is credited to the first half of the fiscal year, which is the second half of the calendar year 1912. This comes about from the fact that most of our street work is completed and accepted during the late summer and the autumn, which means that a report of work completed during any fiscal year is really a partial report of two unconnected working seasons. A report of construction work by calendar years is more logical, but long-established custom has fixed June 30 as the end of the fiscal year in California, and therefore the date for closing municipal reports.

Table 3 shows the total street mileage, together with the mileage of various kinds of street improvements, at the beginning and end of the fiscal year 1912-1913.

HEAT INSULATION TESTS FOR NEW YORK CENTRAL LINES

Some interesting tests are being conducted by the University of Illinois for the purpose of bettering the heat insulating qualities of the walls of railway mail cars.

The Postoffice Department has for some time been trying to secure a car, the walls of which would have a much smaller coefficient of heat transmission than the present type. E. C. Schmidt, professor in the Railway Department of the University of Illinois, knowing of the trouble the railroads were having in trying to construct a better insulated car, took up the matter with A. R. Ayers, general mechanical engineer of the New York Central lines, with the result that a number of experiments are being conducted for the New York Central lines by the university under the direct supervision of Arthur C. Willard, who is professor in charge of the heating and ventilating courses at the university. So far tests have had to do with the amount of heat lost from the car with insulation between the plates and the post construction of the car.

As now constructed, the walls of a steel mail-car consist of two plates about 4 in. apart, the outer 1/8 in. and the inner 1/16 in. thick. Between these plates are vertical steel channels of a modified form, which serve as reinforcement to the plates. The railroads have been working under the impression that the heat loss was intensified by conduction from the inner to the outer wall by this steel channel, and as a result have been placing a 1/4-in. layer of agasote insulating material between the steel plate and the legs of the channel. This is expensive construction, as it is quite a problem to rivet these channels securely with the agasote in place. Moreover, this is being done with no real knowledge of what effect the agasote has on the heat-retaining qualities of the wall.

Professor Willard's apparatus consists of a box, the dimensions of which are 6 ft. each way. The walls of the box are of 7/8-in. tongue and groove siding with 5-in. studding between. The air space is filled with granulated cork. This construction gives a well insulated wall. One side of the box is removable so that different sides may be substituted. The tests consist primarily in determining the heat-resisting qualities of these different sides with various methods of insulation. Heat is supplied to the inside of the box by means of a resistance coil, and the heated air is kept in circulation by an electric fan. The heat input to the box is figured from the total amount of current supplied to both the coil and fan. The current supplied to the fan must be taken into consideration, as its energy is dissipated in the form of heat which is taken up by the air in the box. The inside temperature of the box is ascertained by the average reading of six long-stem thermometers which are inserted at various points.

A coefficient of transmission of 0.096 was obtained using an insulated wooden side. A steel side with 1/4-in. layer of agasote under the channels gave a coefficient of 0.350. The next test to be made is with a steel side having no insulation whatever. After this, a test will be made on a steel section which has the space between the plates filled with some kind of insulating material. Professor Willard is inclined to believe that this method of filling the space between the plates will serve to reduce the heat loss materially. He holds the opinion that the heat loss is not due entirely to conduction, but largely to convection, the air against the inner wall, becoming heated, rises to the top and passes over to the outer wall, where it loses its heat and falls, only to take up heat again and rise. Thus the air between the plates forms an endless chain which carries the heat from the inside of the car. By filling this space these convection currents will be broken up and their effect destroyed. The results of the tests are being anxiously awaited.

HOW TO PUMP OUT A FLOODED PIT WITH THE SHOVEL FEED PUMP

On Duane & Carland's Louisville & Nashville work in Kentucky last spring, shovel operation was frequently interrupted by heavy rain storms which flooded the cut. At one time this became so serious that operation had to be suspended. The water level was over the shovel's journal boxes. It was impossible to move, as the negro pit-men objected to getting their feet wet. The water had to be gotten rid of, but the question was, how? There were no pumps on the job, nor any siphons. The supply pump was submerged and hence useless. Ditching would have taken 20 men a day and a half. Two days at least would have been lost in getting a new pump. At this juncture, Louis Augustine, the shovel runner, came to the front with a suggestion which solved the problem. He disconnected the feed pump on the shovel, cut a piece of pipe 7 ft. long, and attached this to the pump as a suction pipe. This was long enough to reach the bottom of the pit. A 50-ft. piece of 1 1/4-in. hose was used as the discharge. The shovel fireman operated the pump from noon until five o'clock and the night watchman until the next morning. When the day shift arrived the pit was dry.—*Excavating Engineer.*

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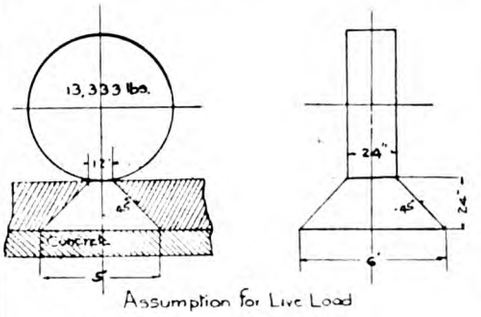
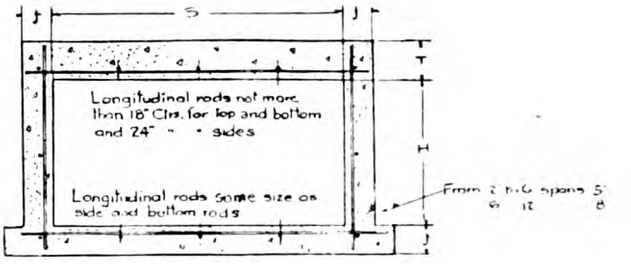
Engineer's Note Book



Assumption for Live Load

20-TON ROLLER



Cross Section of Culvert

TABLE FOR STANDARD CULVERTS.

Loading 20-Ton Road Roller, 13,333 lb. on each wheel
Unit Stresses 16,000 lb., for Steel, 600 lbs. for Concrete, 0.7% of Steel

LOS ANGELES COUNTY HIGHWAY COMMISSION
F. H. Joyner - Chief Engineer
W. D. A.

d = depth of fill H = height of culvert T = thickness of concrete J = " S = span				Top Reinforcement			Side Walls Reinforcement			Bottom Reinforcement			Quantities per lineal ft. of box		
d	H	T	J	Size	Space	Length	Size	Space	Length	Size	Space	Length	Cu. Yds. Con.	Steel lbs.	
8	1'	4½"	4½"	⅜"	6½"	2'-6"	¼"	13"	1'-6"	¼"	13"	3'-5"	0.115	4.73	2'-Span
8	2'	4½"	4½"	⅜"	6½"	2'-6"	¼"	13"	2'-6"	¼"	13"	3'-5"	0.143	5.12	
8'	1'	6"	5"	½"	8"	3'-8"	⅜"	16"	1'-8"	⅜"	16"	4'-6"	0.174	10.32	3'-Span
8	2'	6"	5"	½"	8"	3'-8"	⅜"	16"	2'-8"	⅜"	16"	4'-6"	0.204	11.04	
8	3'	6"	5"	½"	8"	3'-8"	⅜"	16"	3'-8"	⅜"	16"	4'-6"	0.235	12.71	
8	1	7"	5"	½"	7"	4'-8"	⅜"	14"	1'-9"	⅜"	14"	5'-6"	0.222	16.09	4' Span
8'	2'	7"	5"	½"	7"	4'-8"	⅜"	14"	2'-9"	⅜"	14"	5'-6"	0.253	16.91	
8'	3'	7"	5"	½"	7"	4'-8"	⅜"	14"	3'-9"	⅜"	14"	5'-6"	0.284	19.15	
8'	2'	8"	6"	½"	6"	5'-8"	⅜"	12"	2'-10"	⅜"	12"	6'-8"	0.349	20.31	5' Span
8'	3'	8"	6"	½"	6"	5'-8"	⅜"	12"	3'-10"	⅜"	12"	6'-8"	0.386	22.22	
8'	4'	8"	6"	½"	6"	5'-8"	⅜"	12"	4'-10"	⅜"	12"	6'-8"	0.423	23.18	
8"	2'	9"	7"	⅝"	8½"	6'-10"	½"	17"	3'-0"	½"	17"	7'-10"	0.457	29.64	6' Span
8"	3'	9"	7"	⅝"	8½"	6'-10"	½"	17"	4'-0"	½"	17"	7'-10"	0.501	32.35	
8	4'	9"	7"	⅝"	8½"	6'-10"	½"	17"	5'-0"	½"	17"	7'-10"	0.544	33.54	
8'	2'	10½"	8"	⅝"	7"	9'-0"	½"	14"	3'-1"	½"	14"	10'-5"	0.663	42.83	8'-Span
8	3'	10½"	8"	⅝"	7"	9'-0"	½"	14"	4'-1"	½"	14"	10'-5"	0.712	45.97	
8'	4	10½"	9"	⅝"	7"	9'-0"	½"	14"	5'-3"	½"	14"	10'-5"	0.832	47.68	
8'	5'	10½"	9"	⅝"	7	9'-0"	½"	14"	6'-3"	½"	14"	10'-5"	0.888	50.80	
8'	2	12"	9"	⅝"	6"	11'-2"	½"	12"	3'-5"	½"	12"	12'-8"	0.893	59.89	10'-Span
8'	3	12"	9"	⅝"	6	11'-2"	½"	12"	4'-5"	½"	12"	12'-8"	0.949	63.29	
8'	4	12	9"	⅝"	6"	11'-2	½"	12"	5'-5"	½"	12"	12'-8"	1.004	64.99	
8'	5	12"	10"	⅝"	6	11'-4"	½"	12"	6'-6"	½"	12"	12'-8"	1.143	68.53	
8	6	12"	10"	⅝"	6"	11'-4"	½"	12"	7'-6"	½"	12"	12'-8"	1.203	70.38	
8	7	12	10"	⅝"	6	11'-4	½"	12"	8'-6"	½"	12"	12'-8"	1.264	73.63	
8	8	12"	10	⅝"	6"	11'-4"	½"	12"	9'-6"	½"	12"	12'-8"	1.326	75.33	
8'	2	13½"	10	¾"	7½"	13'-3	⅝"	15"	3'-6"	⅝"	15"	14'-10"	1.156	87.90	12'-Span
8	3	13½"	10	¾"	7½"	13'-3	⅝"	15"	4'-6"	⅝"	15"	14'-10	1.218	92.59	
8	4	13½	10"	¾"	7½"	13'-3"	⅝"	15"	5'-6"	⅝"	15"	14'-10	1.280	94.82	
8	5	13½"	10"	¾"	7½"	13'-3"	⅝"	15"	6'-6"	⅝"	15"	14'-10"	1.342	99.60	
8	6	13½"	11	¾"	7½	13'-5"	⅝"	15"	7'-7"	⅝"	15"	14'-10"	1.499	102.42	
8	7	13½"	11	¾"	7½"	13'-5	⅝"	15"	8'-7"	⅝"	15"	14'-10"	1.564	107.21	
8'	8	13½"	11"	¾"	7½"	13'-5	⅝"	15"	9'-7"	⅝"	15"	14'-10"	1.632	109.34	
8	3	13½	11	¾"	7½"	13'-5	⅝"	15"	10'-7"	⅝"	15"	14'-10"	1.700	114.13	
8	10	13½"	11	¾"	7½"	13'-5"	⅝"	15	11'-7	⅝"	15"	14'-10"	1.768	116.26	

Note: This table is calculated for a minimum fill of 8" of rock over culvert slabs and is correct for all fills up to 6' in height.

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Hints on Practice

STARTING VERTICAL GAS ENGINES

By JOHN S. LEESE

After the erection of the engine has been completed, the crankcase should be thoroughly cleaned out, and oil may then be put in up to ½ in. above the strainers which are usually provided for straining the oil used in the forced-feed lubricating system.

Sight-feed lubricators should also be filled; any pipes leading from them should be disconnected as nearly as possible to the point at which they deliver the oil, and the pipes tried to see that enough oil is coming from them. The pipes should then be coupled up again and oil run through them, so that it will get to the part it is intended to lubricate. After starting up, particular attention should be paid to all the connections in these pipes, as leaking joints may involve serious trouble.

If the governor is of the centrifugal type, the governor springs should be uncoupled from the weights and the gear worked by hand, opening and closing the governor valve in order to see that the latter is working freely. The valve should then be set to shut off at the no-load position—that is to say, when the weights are at their widest distance apart. The governor springs may then be replaced and adjustments made so that the governor will completely close the valve at no-load speed. This is a precaution to ensure that the engine will be under the complete control of the governor when it is started up for the first time.

At the first starting up the engine will probably 'hunt,' due to the valve being completely closed at no-load speed, but this 'hunting' can easily be remedied by after-adjustment. On the majority of engines this may be done while the engine is running. The gas and air valve should be adjusted for full load while the engine speed is being set in this manner.

Next oil all moving and sliding parts, such as inlet valve, spindles and guides, rocking levers, push rods, etc., and fill any lubricators and grease cups. After this has been done the engine should be barred round by hand to make sure that nothing is touching and that all is clear inside the crankcase.

Setting of the ignition should be checked over to see that the spark, when fully advanced, takes place about 25 to 30° before the dead centre. The angle may be conveniently checked by an adjustable spirit level.

When the engine is still being barred round, it should be noticed that there is enough clearance between all levers, valve rods, and the valve stems, so that all the valves will close tight. Valves held from their seats will result in pitting and corrosion, and also in leakage of compression and explosion pressures. When the barring round is finished the engine should be left in the starting position; that is to say, 35 to 40° after the firing point on any of the cylinders which are fitted with air-starting gear.

Next, all the necessary main valves—for instance, the exhaust, gas supply to engine stop-valve, and air supply to engine stop-valve—should be opened. The circulating water valve should be opened immediately after the engine has started. The by-pass valve on the pressure gauge connected to forced-lubrication systems should be practically throttled off. This is necessary so that the oil will get to the bearings in the shortest possible time on the first starting up. After running for a little while the valve may be adjusted so that the correct amount of pressure is registered on the gauge.

The gas cock in the engine manifold can now be opened, the gas and air mixing valve adjusted, the ignition switched on, and the engine started by suddenly turning on the compressed air. The engine should start firing after making 4 or 5 revolutions. As soon as the engine gets away on the gas the compressed air must be shut off and the oil pressure gauge watched so that the pressure can be reduced to its correct amount before the gauge pointer reaches the end of its scale. If this precaution is not taken, some damage may be done to the gauge, and possibly to the piping system. The by-pass should be adjusted so that a steady pressure is recorded on the oil system.

The engine should now be allowed to run for 15 minutes or so, while the attendant adjusts the water supply to each cylinder by closing the valve serving each cylinder and opening it for three turns. By this means an equal quantity of water will be supplied to each cylinder. Should any one cylinder appear to heat up more than the others, the water supply for this cylinder may be increased and the valve adjusted until all are at an equal temperature. During this run the speed of the engine should also be checked, and with a full-load mixture on the mixing valve all hunting should be eliminated.

If it is necessary, tension of the main governor springs may be altered, or this may be done later. After say half an hour's run, provided there is in the meantime no appearance of undue heating, the engine should be shut down and all the inspection covers removed from the crankcase for an examination of the bearings, rod-ends, and camshafts. If everything is all right, the doors may be put back again ready for further running. In this connection it will be noticed that on no account must a naked light be taken into the crankcase. Serious explosions, with injuries to the inspector, have often occurred through neglecting this precaution.

The main governor springs should be the correct tension to account for 95% of the speed, and at this speed there should be practically no tension on the auxiliary speeder spring. If the speeder springs are used for more adjustment than this, coarse governing will follow.

The engine may be started up again and run for a quarter of an hour or so at full speed. If at the end of this period the bearings are still cool, full load may be put on the engine.

It often happens in new engines that when they are called upon to run light for considerable periods the spark plugs become wet with oil, and consequently misfire. This is due to the new rings not being properly bedded into the cylinders, thus allowing oil to be forced up into the combustion chamber. Before going on load, therefore, it is advisable to examine the spark plugs so that there will be no misfiring on the light load.

Another frequent cause of misfiring at light loads with quantity governing is insufficient compression. By opening the indicator cocks it will be easy to determine which cylinder is misfiring. The remedy is to adjust the governor mixing valve so that it takes more gas at high speed and to adjust the supply of mixture by the plug cocks.

Best results are procured by allowing the jacket water to leave the cylinders about 130° F., or at a temperature as hot as one can bear on one's hand.

After having had the engine running on full load for some hours, and after the crankcase and parts have become fairly heated up, it may be found that the exhaust valves are not seating. This is due to the expansion of the spindles reducing the clearance between the rockers or tappet rods and the valve stems. In cases where the valve rockers are mounted on the cylinders, the expansion of the latter will increase this clearance instead of decreasing it. This will mean insufficient opening of the valve. The correct clearances for the inlet and exhaust valves vary with the size of the engine, but the manufacturers will invariably supply these figures on request, and they should be checked when the engine is cold.

For constant quality variable quantity governing the following mixtures are approximately correct: City gas, 500 B.t.u. per cu. ft., 8 volumes of air to 1 of gas; producer gas, 135 B.t.u. per cu. ft., 2 volumes of air to 1 of gas; coke-oven

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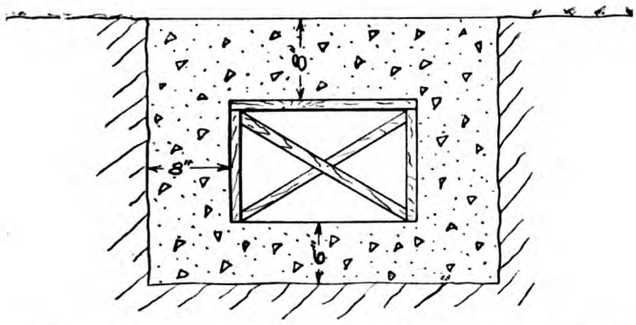
gas, 400 B.t.u. per cu. ft., 5 volumes of air to 1 of gas; blast-furnace gas, 90 B.t.u. per cu. ft., 1.5 volumes of air to 1 of gas.—*The Isolated Plant.*

SIMPLE METHODS OF CONSTRUCTING CONCRETE CULVERTS

Culverts on the farm might be likened to the old Forty-niner's comment on the practice of carrying a pistol. As he put it, a gun was something one might not need for a long time, "but when you do need it you need it mighty bad." Every farmer will recognize the application. Perched upon a loaded wagon he has driven out of a field into his lane or the public road and dreaded crossing the intervening ditch that marked the boundary. The down-pitch and jolt of the wagon, then the strenuous pull and wrench required to get it up the other side of the ditch spelled wear and tear in large letters, with too often things actually broken or part of the load dumped off. Again, there is the place in the lane that every torrential rain washes into a gully, or the muddy ditch in close proximity to the house or barn.

The farmer is foolish to submit to all this annoyance, inconvenience, and exasperation when it is so easy to establish culverts that will remedy the situation effectually and permanently. With little effort and at small expense he can put down imperishable concrete culverts.

Concrete culverts are built several ways. The purpose here is not to consider the more complicated and expensive types, but culverts of the most economical construction, such as will not only take care of water, but serve as little bridges over ditches or depressions in a road or driveway.



For example, having determined the required size of the culvert and having made the proper excavation, place in the latter 6 in. of concrete consisting of 1 part portland cement, 2 parts sand and 4 parts stone, the stone graded from ¼ to 1 in. If crushed stone is not available use 1 part portland cement and 5 parts of gravel, if the gravel is clean and well graded. After placing a 6-in. bed of concrete in the bottom of the excavation erect board forms as shown in the accompanying drawing, bracing them at each end as indicated. The width and depth of the excavation should be such as to allow an 8-in. concrete covering at the top and sides of the form. After the concrete has hardened the inside braces are knocked away and the side forms allowed to collapse, which will also release the upper or top board. This will give a flat concrete arch of great strength and the method of constructing it is as simple and economical as could well be devised. Where a very small drain is required and the farmer happens to have some old terra cotta pipe on hand, he could resort to the same method of building a culvert with a round instead of square or rectangular opening, allowing the pipe to remain.

In the case of the culvert first described, old lumber free from knot-holes or other openings would answer for forms. Construction of this type would be especially convenient for the short drains often required in the vicinity of the house or barn.

By remembering that a barrel of cement will make about 25 cu. ft. of concrete of the proportions given above, it will be easy to calculate approximately the amount of cement required for a culvert of given dimensions. In building culverts of this character the farmer should be careful to have clean sand and well-graded aggregates and be patient enough to allow the concrete to harden thoroughly before using the culvert, say for a period of two weeks. More failures are caused by the use of dirty sand, unsuitable aggregates, and undue haste in the removal of forms and premature use of construction than are caused by defective cement.

One of the greatest virtues of cement is that it can be employed in just such simple and inexpensive ways as are described above. If the farmer would exercise his ingenuity and inventive talent he could use concrete for many other improvements of like simplicity and low cost.

Company Reports

Standard Oil

Standard Oil Company of California, according to *Oildom*, was incorporated in 1906 under the laws of California. Operation, however, began in 1900, when the Standard Oil Company purchased the stock of the Pacific Coast Oil Company.

Capital Stock—$100,000,000 is the authorized capitalization since March 16, when the stockholders voted on a resolution to this effect passed by the directors on January 6. The original capital was $25,000,000 but after dissolution, the stockholders on July 20, 1912, authorized an increase to $50,000,000 and rights to subscribe to 80% of their holdings at par were accorded the stockholders. 45,184 shares remaining in the treasury were offered for subscription to share-holders between February 2 and March 10, 1914.

Dividends—Since the dissolution, dividends have been paid as follows: 1912, November 15, 2½%; 1913—March 15, 2½%; June 14, 2½%; September 15, 2½%; December 15, 2½%; 1914—March 16, 2½%; June 15, 2½ per cent.

Properties—This Company represents a complete cycle in the oil business, inasmuch, as it owns producing property, conducts its own pipe-lines and water transportation, runs three refineries, and conducts its own marketing along the Pacific Coast and in the Orient. A history of the Standard Oil Company in California is a history of the oil industry in that state. The production of California dates from 1876, in which year a small refinery was built and another in 1878, but the cost of producing and refining exceeded the returns and the plants were dismantled and abandoned. In 1879, the forerunner of the Standard Oil Company, the Pacific Coast Oil Company, was formed. San Francisco men with abunddant capital were back of the Company and operations were begun on a large scale. New wells were put down, a refinery with 600 barrels daily capacity was constructed, and pipe-lines from the wells to the refinery were laid, and to handle the water transportation, a tank steamer of 6000 barrels capacity was built. But the Company was operated at a great loss. The California oils were stubborn and would not yield to the then known methods of treatment, so that a satisfactory illuminating oil could be made. About the year 1890, the Pacific Oil Company entered into an arrangement whereby the stock was sold to the Standard Oil Company.

Refineries—At Richmond, on San Francisco bay, the Company operates the largest refinery in the world, with a daily capacity of 60,000 barrels, which is operated 365 days a year. In the beginning of 1912 President Scofield called attention to the fact that large expenditures were about to be made in improvements and extensions that were necessary to handle the rapidly increasing trade. In 1913, two refineries were completed and put into operation. El Segundo refinery with a

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capacity of 15,000 barrels daily was completed in the record time of 139 days from the time the first ground was broken. This plant will take care of Southern California and Arizona, as well as export territory. The plant has storage capacity of 275,000 barrels of crude oil and 1,085,000 barrels of refined oil and has an acid plant with a daily production of 24,000 lb. of sulphuric acid. The plant is in close proximity to the Fullerton oilfields, a distance of 23 miles, where the Company has production of its own sufficient to tax the capacity of the refinery to its utmost without taking into consideration the possibilities of increased production. The refinery is situated on ocean frontage near Los Angeles. Another new refinery was completed and placed in operation in November, 1913, at Bakersfield, in the heart of that producing region, which is also supplied by production from the Company's own property. During 1913 about 25,500,000 barrels of crude will be refined by the Company to supply its domestic and foreign requirements, compared with 19,000,000 barrels in 1911 and 1912.

Production—Two years ago the Company's wells were producing an average of 10,000 barrels per day. Within the last four months the Company has brought in three wells, each one of which has a production of over 10,000 barrels daily. They are No. 7, production 10,000 barrels of 24 gravity and No. 10, production 12,000 barrels of 28 gravity, both in the Whittier-Fullerton field. Well No. 10 in Midway oilfield brought in in September produces 15,000 barrels of high grade oil of 31.4 gravity. This property adjoins the property of the Murphy Oil Company, which was leased by the Standard in November, and on which drilling operations will be begun at once. If any success is attained the Company will have production enough to supply its refineries, calling for about 100,000 barrels, and reap the fruits of former labors. The Company expended more than $14,000,000 in its history in exploring the oilfields of California before receiving one dollar of profit in return, and the greater proportion of such profits that have been made, were reinvested in the construction of new plant and additional facilities needed to handle the continual increased production of crude oil over the current consumption. The total enterprise represents today an outlay of $70,000,000, which includes a large fleet of vessels used for transporting oil.

Net earnings for 1913, compared with previous years, follows:

	1913.	1912.	1911.
Net	$19,386,140	$7,106,156	$3,141,626
Dividends	4,493,399	1,123,349	.....
Surplus	14,892,741	5,982,807	3,141,626

The balance sheet compared with previous years, follows:

	1913.	1912.	1911.
Assets			
Plant	$50,268,456	$38,241,001	$30,334,424
Other investments	190,750	190,750	190,750
Inventories	21,724,390	19,246,014	14,585,285
Accounts receivable	6,247,231	4,317,778	3,347,497
Cash and coll. loans	1,065,266	5,320,360	980,479
Prod. prop., prod. val.	8,474,659	.....	.....
Total	$87,970,754	$67,315,903	$48,938,435
Liabilities			
Capital stock	$45,183,993	$44,933,994	$25,000,000
Capital stock premium account	250,000	.....	.....
Notes and accounts payable	7,448,017	2,185,907	9,725,240
Profit and loss surplus	35,088,743	20,196,002	14,213,195
Total	$87,970,754	$67,315,903	$48,938,435

The Company operates about 350 miles of main trunk pipelines from the Bakersfield region to the Point Richmond refinery. On August 10, 1913, the Company reluctantly became a common carrier in compliance with the law of that state. The Company owns a fleet of 27 vessels, two of which, the *Richmond* and the *El Segunda* were completed in 1913 at an estimated cost of $1,720,000. Its marketing facilities extend over the states of California, Oregon, Washington, Arizona, Nevada, Alaska, and Hawaiian Islands, while its foreign business is in India, Java, Japan, and the west coast of Central and South America. Two-thirds of the entire output of illuminating oil is exported.

The new ten-story office building in San Francisco was completed and ready for occupancy in June, 1913. The cost of the building was $1,000,000.

It is interesting to give the official statement of President Scofield, issued with the annual report, which is as follows:

Without going into unnecessary detail, would state to the stockholders that of the net earnings for the year $10,911,481 has resulted from the profits derived in the ordinary course of the Company's business, and $8,474,659 from the increase in values of the Company's producing properties, which are based upon the regulations of the U. S. government in fixing their status for our returns to the U. S. Internal Revenue Department for the payment of excise taxes.

The increased production from the Company's own properties and its permanency during the year 1913 has been most satisfactory, the average daily production during the year 1912 having been 10,846 barrels per day, and during the year 1913, 26,575 barrels per day; while during the month of December, 1913, the average daily production was 39,572 barrels, which is still being maintained at that figure.

Of the accounts payable $629,695 is payable in oil on an arrangement whereby the Company has been exchanging heavy or fuel oils for lighter crudes; $4,000,000 is the balance due in deferred payments to the Murphy Oil Company, extending through a period of five years, and will be paid out of the production from the Murphy properties. The balance of accounts payable is the ordinary monthly indebtedness, which is paid from month to month currently for the preceding calendar month.

In the acquisition of the Murphy properties, there was issued to the Murphy Oil Company as a part consideration 2500 shares of the capital stock at a basis of valuation of $200 per share, amounting to $500,000. The $250,000 premium derived from such issue was not treated as a profit, but capital stock was credited at par and $250,000 carried as a liability under capital stock premium account.

All the physical plants of the Company, comprising refineries, pipe-lines, vessels and sales department equipment, while being maintained to the highest point of efficiency, have been depreciated at a rate of not less than 7½% per annum and charged off to profits and losses, before the determination of net profits.

The Board of Directors of the Standard Oil Company (California) desires to state in explanation of the proposal to increase the capital stock of the corporation, that the consummation of the sale of the recent allotment of 10% pro rata to stockholders of record as of February 2, 1914, will practically exhaust the treasury stock, leaving less than 3000 shares in the treasury for future disposal out of the present authorized issue of $50,000,000.

As the stockholders are aware, a very large proportion of the earnings of the Company for many years past, instead of being returned to them currently in dividends, has been carried to surplus account and necessarily used in the expansion of the business, such surplus accounts as of December 31, 1913, being $20,196,002.35, and which will be very largely augmented by the earnings of the year 1913 over the amount declared currently during that year in dividends.

It has, therefore, been considered advisable, for many reasons, to have the authorized capital stock of the Company approximate closer to the net assets of the Company than it has in the past.

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The Beaumont Gas & Power Co. reports for 1913 as follows:

ASSETS

Fixed capital	$31,987.79
Accounts receivable	191.76
Other assets	138.30
Total	$32,317.85

LIABILITIES

Capital stock	$25,000.00
Funded debt	6,000.00
Accounts payable	174.30
Other liabilities	39.54
Surplus	1,105.01
Total	$32,317.85

PROFIT AND LOSS

Operating revenue	$ 4,520.23
Operating expenses	4,727.54
Net operating revenue	$ 792.69
Taxes, interest, etc	517.33
Net balance	$ 275.36
Balance December 31, 1912	829.65
Gross balance	$ 1,105.01

The Consolidated Utilities Corporation reports for 1913 as follows:

ASSETS

Fixed capital	$ 8,615.56
Investments	2,383.93
Total	$10,999.49

LIABILITIES

Accounts payable	$ 8,000.00
Surplus (investment)	2,999.49
Total	$10,999.49

PROFIT AND LOSS

Operating revenue	$ 5,556.03
Operating expenses	4,068.09
Net operating revenue	$ 1,487.94
Less taxes, interest, etc	560.00
Net balance	$ 927.94
Balance December 31, 1913	2,071.55
Balance	$ 2,999.49
Transferred to fixed capital	$ 418.32
Reserves invested in sinking fund	2,581.17
	$ 2,999.49

Following the lead of the Standard Oil Co., which has incorporated separate companies to conduct its business in the various states in which it operates, the Shell-Royal Dutch syndicate, according to press reports, announced its intention to seek a California charter for its rapidly increasing business interests in this state. The new corporation will probably be known as the Shell Company of California. Its capitalization has not yet been definitely determined, but $50,000,000 was spoken of as the probable amount of the authorized stock issue. The new company will be both a holding and operative concern, and as such it will control the operations of the Turner and W. K. Oil companies, the Valley Pipe-line, the California Oilfields, Ltd., and the American Gasoline Co. It will also operate the new refinery to be built at a site across the bay, probably in the neighborhood of Martinez, and any other refineries that it may deem necessary for successful competition with the Standard Oil, the Associated, the Union, and the General Petroleum for its share in the California oil business in all its branches. The syndicate's fleet of steam tankers, the first of which will leave the ways before the end of the current year, will also be held and operated by the new company. They will be utilized in the coastwise trade and will fly the American flag. It is understood that the Rothschild syndicate is greatly impressed with the permanency of the California oil deposits; that experts employed by them have in no instance reported a probable duration for the oil supplies of less than 100 years; and that hence this controlling factor in European finance has signified its intention to its local representatives to expend large sums in securing additional properties and in bringing those now owned to the highest stage of productiveness. The incorporation of this local company is the first step toward this end.

The Surprise Valley Electric Light & Power Co. reports for 1913 as follows:

ASSETS

Fixed capital	$16,160.39
Cash	61.96
Accounts receivable	578.60
Investments	17,600.00
Other assets	171.00
Total	$34,571.95

LIABILITIES

Capital stock	$25,000.00
Installments on stock subscription	43.00
Accounts payable	6,920.72
Reserves	80.47
Other liabilities	824.52
Surplus	1,703.24
Total	$34,571.95

PROFIT AND LOSS

Operating revenue	$ 3,617.11
Operating expenses	2,692.79
Net operating revenue	$ 924.32
Less taxes, interest, etc	608.17
Balance, operating revenue	$ 316.15
Balance December 31, 1912	3,027.78
Net balance	$ 3,343.93
Other deductions	1,640.69
Balance	$ 1,703.24

The Rialto Light, Power & Water Co. reports for 1913 as follows:

Operating revenue	$ 15,207.14
Operating expenses	4,344.95
Net operating revenue	$ 862.19
Non-operating revenue	15.00
Total revenue	$ 877.19
Balance December 31, 1912	2,891.57
Total	$ 3,768.76
Additions	34.60
Balance December 31, 1913	$ 3,803.36

The unfilled tonnage of the *United States Steel Corporation* on May 31 was 3,998,100, a loss of 278,908 tons since April 30.

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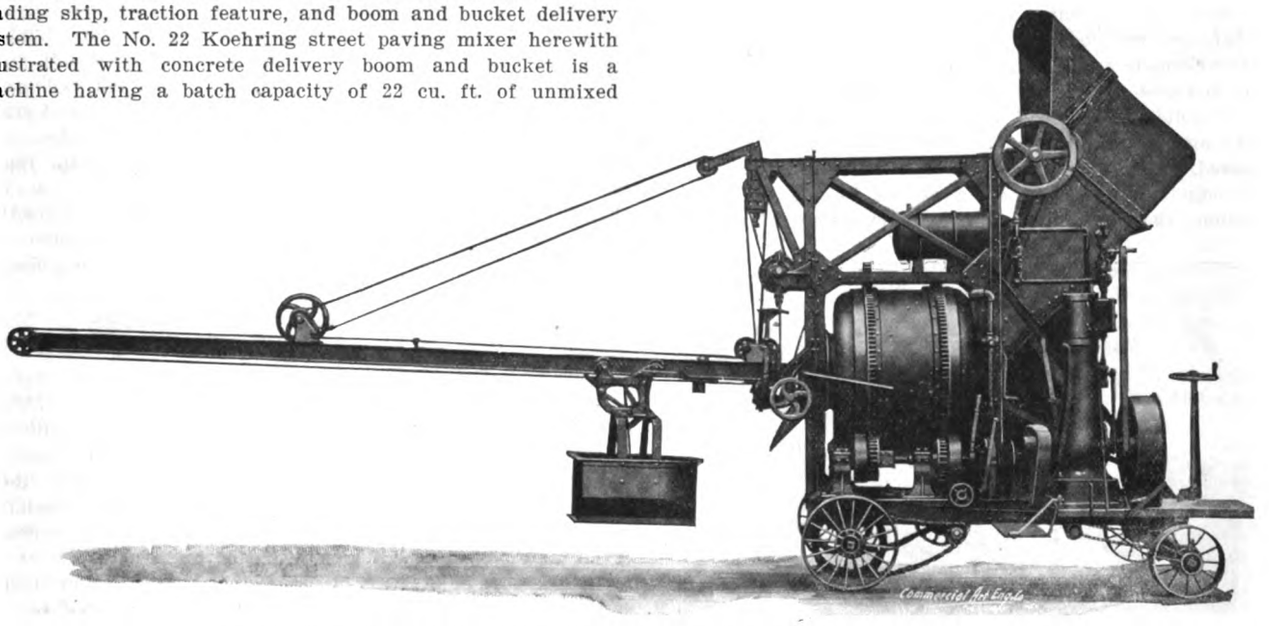
Industrial Progress

STREET PAVING MIXER

In the early development of the concrete mixer it was customary for manufacturers to talk of the form of mixing chambers as a most important consideration in selecting a machine. At the present time, however, the drums of nearly all mixers are of a standard form of design and the variation of the interior mixing fins is very much the same. Therefore, the utilization of the inner segment of the discharge chute in the Koehring mixer enables that machine to produce three independent or opposed mixing actions, the result of which is thoroughly mixed concrete in a few seconds.

Just as the Koehring Machine Company designed its mixer so that the mixing chamber would save time for the contractor, so in the development of a paving type of machine it has taken full advantage of time-saving devices in the loading skip, traction feature, and boom and bucket delivery system. The No. 22 Koehring street paving mixer herewith illustrated with concrete delivery boom and bucket is a machine having a batch capacity of 22 cu. ft. of unmixed material or 17 cu. ft. of mixed concrete per batch. This machine is rated to load, mix, and distribute under one-man control 1800 sq. yd. of 6-in. concrete pavement. The loading skip is of the open end type of sufficient width that two wheel-barrows may be discharged simultaneously, and is so designed that when elevated, the angle of flow is so pronounced that no trouble is experienced due to aggregates clogging the chutes. The water measuring tank is of the automatic measuring type and the right amount of water is introduced by throwing the single lever. The drum consists of but three pieces, the two heavy cast semi-steel heads, and the central shell of boiler plate steel. Double gearing is used because it produces a more perfectly balanced drive and in case of stripping the teeth on either gear, the one remaining is sufficiently strong to operate the mixer. These two heavy castings contain the milled trunnion roller faces and the two large gears just mentioned. This type of head construction permits rounding the corners of the drum, minimizing the tendency of the concrete to pocket. With this construction, flanged splash rings may be used so that the gears are kept free from concrete. The discharge chute, as has been mentioned, performs one-third of the mixing and by an ingenious system of leverage, is under quick and accurate control.

The Koehring paving type of machine may be equipped with the discharge chute, comprising several sections of open chute, or the I-beam delivery boom and bucket may be used. In the east and middle west the latter method of delivering the concrete has met with great favor and has been used in the state of Washington by most of the leading paving contractors. By the boom-and-bucket method, the boom may be swung 180° and the concrete automatically discharged at any point within the half circle as predetermined by the operator. The use of an ingenious arrangement on the bucket assures the automatic discharge, close, and return of the bucket after the load is placed in it. The I-beam may be furnished in lengths up to 30 ft. although 20 ft. is the standard length. The illustration shows a steam driven machine, although most of the pavers used on the Pacific coast have been of the gasoline driven type. The power used for driving the mixer is used for moving the machine forward along the line of work. The traction feature and the fact that the mixer loads at one end and discharges at the other permits placing the aggregates in a long pile at the side of the road being constructed. The points of superiority which are claimed for the Koehring mixers, which are made in both the paving, and standard or side discharge styles, are not that they are the best mixer or better than some other machine, but that examination by any careful buyer will convince him that size for size these machines will deliver more concrete with less men and do work longer with fewer repairs.



No. 22 KOEHRING STREET PAVING MIXER, WITH CONCRETE DELIVERY BOOM AND BUCKET.

In the Koehring catalogue No. 19 bearing the imprint of the California agents, Harron, Rickard & McCone of San Francisco and Los Angeles, some 40 pages are devoted to showing all of the sizes and combinations manufactured and half-tones of some of the representative jobs on which Koehring mixers have been satisfactorily used. This catalogue also gives complete specifications for all of the 12 sizes manufactured.

The General Electric Co., of Schenectady, New York, is supplying the Alaska Gastineau Mining Co. at Sheep creek, Alaska, with 35 additional motors ranging from $7\frac{1}{2}$ to 300 hp. The Anaconda Copper Mining Co., Butte, will install 23 additional induction motors ranging from 5 to 20 hp., with starting compensators and 10 oil switches. The Tomboy Gold Mines Co., Telluride, Colorado, will place in operation in its mines a 4-ton electric mining locomotive which was recently purchased from this Company. The Arizona Copper Co., at

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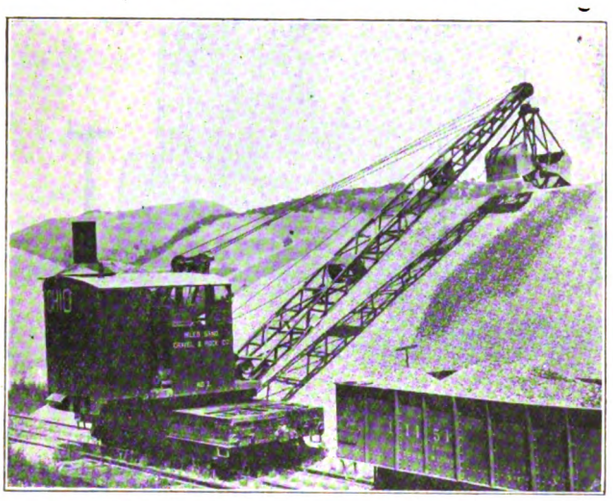
Clifton, will add to its electric equipment at 150-hp. induction motor and two 3-bearing 17½-kw. motor-generator sets. The Anaconda Mining Co., Butte, Montana, has purchased for installation in the plant of the International Smelting & Refining Co., Miami, Arizona, two 200-kw. 3-bearing synchronous motor-generator sets. The Alaska Treadwell Gold Mining Co. has ordered three additional 75-hp. induction motors with compensators. The Champion Copper Co., Painesdale, Michigan, will place three new 4-ton electric mining locomotives in operation at its plant, all of which equipment is being supplied by the General Electric Company.

LOCOMOTIVE CRANES

Among the machines and appliances which not many years ago were looked upon as superfluous and as having a limited application, but which today have come to be recognized as standard equipment in the conduct of large scale mining and smelting operations, the locomotive crane may be prominently mentioned. This machine, which is fast finding favor among the operators, has been adapted to various uses by the miner and smelterman and has proved itself to be a great labor saving and cost reducing machine. In construction work the crane supplies an efficient means for the handling of machinery and materials and after the smelter or mill has been completed, the crane is employed for the handling of supplies and products. In the handling of ore in open-cut mining operations the locomotive crane is invaluable for lifting



LOCOMOTIVE CRANE IN OPERATION.

drills, handling broken ore and waste, lifting cars, and moving supplies. In bench operations the crane is well adapted for the transfer of drills, supplies, etc., from one level to another. In the illustration is shown an Ohio locomotive crane used for reclaiming and loading.

With the increased use of cranes of this type the requirements have become more exacting as to material and adaptability. The breakages in parts usually involved castings and materials of fragile nature, which resulted in delays and cessation of work while repairs were being made. This objection was increased by the manufacturers frequently charging heavily for any repairs or spare parts, which led to no little dissatisfaction. The modern crane has been modeled and built with the object of simplicity in design and durabilty in construction, providing accessibility to all parts of the machinery and representing such construction as will render the crane almost immune to injury with ordinary care. In the Ohio crane this feature has been given careful attention, and in order to make it as immune to injury as possible steel castings are employed where gray iron castings are the ordinary practice.

The capacity of a locomotive crane is based upon the maximum safe working load which the crane can handle at a 12-ft. radius; that is, horizontal distance between the crane's axis of rotation and a perpendicular line through the centre of the hoisting hook or grab bucket, as the case may be. The cranes are built for standard-gage railroad track, 4 ft. 8½ in., but wider gage may be had if so desired. The main base of the Ohio is one large steel casting, this being used to avoid breakage and the common annoyance from loose bolts. The turntable revolves upon four bevel steel rollers of large diameter. The steel track upon which they operate is 8 ft. diameter. In that the machine is very heavy, counter-weights and scrap iron ballast are dispensed with.

Vertical tubular boilers are used and the engines are of the horizontal double cylinder non-reversing type. The cylinders are jacketed with magnesia blocks which are covered with sheet steel. The boom is of structural steel and operated by a heavy bronze worm gear keyed to the boom drum shaft and engaging a steel worm with heavy turned threads. Cast iron sheaves, plow steel rope, steel fall-blocks, cast iron drums, bronze bearings, forged steel shafting, cone friction clutches, foot brakes, steel gear, compression grease cups, oil cups, wells, and channels are all given careful attention in locomotive crane construction with the result that the finished crane is adapted to meet the hardest of working conditions. The Ohio Locomotive Crane Company at Bucyrus, Ohio, represented on the Pacific Coast by the Edward R. Bacon Co., San Francisco and Los Angeles, is producing what is claimed to be one of the most modern types and one which embodies the results of years of experience in crane construction and design.

OIL-DRIVEN AIR-COMPRESSORS

The increased use of low-grade oil fuel for power purposes has led to the design, by the Ingersoll-Rand Co., of the oil-engine-driven air-compressor. This is of the direct-connected straight-line type, and somewhat resembles in this respect, as well as in the design of the air end, the Company's standard line of small compressors. The main frame is designed for a splash system of lubrication, is of the wholly enclosed type, and provided with removable covers.

The feature of greatest interest is the design of the driving end. This consists of a single oil-engine cylinder set behind the air cylinder, and directly connected, by means of an extended piston rod, to the air piston. It follows in general design a type known as the 'hot bulb' engine, which combines a high thermal efficiency with simplicity of construction. The power cylinder is of the single-acting two-cycle type. It is water-jacketed, provided with an efficient system of lubrication, and of sturdy design. It is fitted with a torch for heating the ignition bulb preliminary to starting. After the compressor is under way this torch is dispensed with.

The fuel is automatically injected into the combustion chamber by means of a small pump, on the side of the frame, operated by the main shaft. It enters in the form of a finely atomized spray and is immediately ignited by the hot bulb, dispensing entirely with the electric spark and batteries. The stroke of the fuel pump is regulated by a centrifugal governor in the fly-wheel, thus regulating the amount of fuel injected into the cylinder in proportion to the load. This is supplemented by a regulating device on the intake to the air cylinder of standard design.

The operation of this machine is accompanied, it is claimed, by none of the losses common to the average two-cycle gasoline engine, in which part of the incoming charge follows the exhaust gases through the outlet ports and is wasted. This is due to the fact that the fuel is not vaporized by an outside agency and introduced with the air used for scavenging, but is injected directly into the cylinder at the end of the compression stroke, as already mentioned.

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Book Reviews

TESTS OF BOND BETWEEN CONCRETE AND STEEL. By Duff A. Abrams. This forms Bulletin No. 71 of the Engineering Experiment Station of the University of Illinois. This bulletin furnishes one of the most exhaustive studies of the amount and distribution of the bond stress between concrete and steel which has appeared. The results of tests of about 1500 pull-out specimens and 110 large reinforced concrete beams are given. The tests covered a wide range of ages, mixes, size of bar, length of embedment, condition of storage, method of applying the load, etc. Both plain and deformed steel bars were used. Bond resistance may be divided into two principal elements: adhesive resistance and sliding resistance. In all of the tests, measurements were made to determine the relation of slip of bar through the concrete to the bond resistance at different stages of the tests. A considerable bond resistance is developed before a measureable slip is produced. It was found that after slipping begins there is a well defined relation between the amount of slip of bar and the bond resistance for small slips. For plain bars slip begins at about 60% of the maximum bond resistance; with further slip the bond resistance increases rapidly until a slip of about 0.01 in. is reached which represents the maximum bond resistance. The amount of slip corresponding to a given percentage of the maximum bond resistance is remarkably constant for a wide range of ages, mixes, conditions of storage, etc. Slip of bar begins at a bond stress equal to about one-sixth of the compressive strength of cubes made from the same concrete. The maximum bond resistance is equal to about one-fourth the cube compressive strength. For deformed bars the relation of slip of bar to the bond resistance was not materially different from that of plain bars during the early stages of the test; during the later stages of the test the bond resistance varied widely with the type of bar and was found to depend on the area and slope of the bearing surfaces presented by the projections of the bar. Twisted square bars were found to be inferior to plain round bars on the basis of bond resistance per unit of area of the surface of the bar. The usual method of computing the bond stress in a reinforced concrete beam does not take account of all the phenomena of bond action. Slip was first observed in the middle region of the span at loads producing a tensile stress in the reinforcement of about 6000 lb. per square inch. As the load was increased, slip of bar progressed through the outer thirds toward the ends of the beam. In the beams reinforced with plain bars, end slip began at about 67% of the maximum load; for the beams with certain types of deformed bars, the value was 51%. In the tests of reinforced concrete beams it was found that a very small amount of end slip represented critical conditions of bond stress. Copies of Bulletin No. 71 may be obtained gratis upon application to C. R. Richards, acting director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

STEAM TURBINES. By James Ambrose Moyer. John Wiley & Sons, N. Y. P. 368. Index. For sale by the *Mining and Scientific Press*, San Francisco. Price $3.50.

The author draws attention to the remarkable progress that has been achieved in steam turbine design during the past few years and brings out the fact that the steam turbine is the oldest and at the same time the most modern steam motor. This is the second edition of Mr. Moyer's work, the first having been published in 1908. Since the first edition was published the evolutionary tendency in the adoption of types of steam turbine has been toward a concentration upon practically four instead of the many designs in vogue at the time the first edition was published. A tendency toward the installation of increasingly large sizes is also pointed out. An instance is cited of the largest turbo-generator now installed rated at 35,000 kw. in comparison with a maximum size of 14,000 kw. only three years ago. This concentration of power in large units shows an extension of the principle of consolidation that has made itself manifest in many other directions and has resulted in a great reduction in the cost of power of this kind per kilowatt installed. New chapters have been added on bleeder or extraction turbines and on mixed pressure turbines. The chapters on heat theory, steam flow, nozzle, blade, and re-action turbine design have been re-written with the addition throughout the text of many illustrative examples. The appendix has been enlarged by the addition of many practical exercises and problems illustrating important parts, thus increasing the usefulness of the book as a classroom text. A new entropy total heat chart has been calculated and engraved, which embodies the most recent and reliable data on the properties of super-heated and saturated steam.

AMERICAN ELECTRICIANS' HANDBOOK. Compiled by Terrell Croft. McGraw Hill Book Co., N. Y. P. 692. Index. For sale by the *Mining and Scientific Press*, San Francisco. Price $3.

This work is intended especially for practical electrical men, wiremen, contractors, linemen, superintendents of small plants, operators and construction engineers; in short for the type of man who is called upon to install and use the apparatus that has been designed by the electrical engineer. The preparation of the subject matter has been a process of compilation, the greater part of the data having been taken from the notes of the compiler. Many abstracts are given from standard books and from technical magazines. Theoretical questions have been avoided as much as possible, the data presented being confined entirely to established practice as it existed up to the time of publication. The subject matter is divided into six sections under the general headings of Fundamentals, Generators and Motors, Outside Distribution, Interior Wiring, Transformers, and Illumination.

COMPRESSED AIR PRACTICE. By Frank Richards. McGraw-Hill Book Co., N. Y. P. 319. Index. For sale by the *Mining and Scientific Press*, San Francisco. Price $3.

In the author's preface Mr. Richards draws attention to the fact that the cost of power and fuel for the compressed air now used is not more than ⅓ as great per quantity unit as it was 20 years ago. This statement in itself is significant of the wonderful changes that have been made during the last two decades in the design of compressed air apparatus. Mr. Richards' work, while not voluminous deals in general with all of the more prominent applications of compressed air, as well as giving a brief discussion of the elementary principles and fundamentals involved. The matter of the design of the compressors themselves is not taken up and, as Mr. Richards says, "Catalogue literature and auctioneer talk have their places, but not here." As a book of reference to the busy man this work is of exceptional value and blazes the trail for those who desire to undertake a detailed investigation of any specific application.

EXCAVATING MACHINERY. By Allen Boyer McDaniel. McGraw-Hill Book Co., New York. P. 326. Index. For sale by the *Mining and Scientific Press*, San Francisco. Price $3.

This is an exceptionally comprehensive work dealing with an interesting phase of engineering construction. The author has treated his subject in ten chapters and two appendices, each chapter being devoted to one specific type of excavator. In addition to discussing the structural details, peculiarities of design, and correct application of each, the author has succeeded in compiling a great deal of data concerning the actual use of each in various localities. A quantity of cost data is given in each case which adds very materially to the value of the work. This is one of the best works of its kind

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that has come to this desk and will constitute a valuable addition to the libraries of all engineers and contractors interested or engaged in construction work.

The Official Good Roads Year Book of the United States. Published by the American Highway Association, J. E. Pennybacker, editor, Charles P. Light, business manager. Colorado building, Washington, D. C. P. 500. Price $1.

Everyone interested in the good roads movement in the United States is familiar with the work of the American Highway Association of which Logan Waller Page, director of the U. S. Office of Public Roads, is president. This work in addition to giving the various technical papers read before the 1913 Road Congress, devotes a great deal of space to the activities of other good roads organizations. Summaries are given of the legislative enactments in various states in the Union as well as in foreign countries pertaining to good roads and various allied subjects. Specifications adopted by various states are also given in detail together with lists of state highway officials, state and United States government reports, and a summary of bonds issued and funds available for road construction in 1914.

Compressed Air. By Theodore Simons. McGraw-Hill Book Co., N. Y. P. 160. Index. For sale by the *Mining and Scientific Press*, San Francisco. Price $1.50.

This work has been prepared primarily for the use of students who desire to obtain an insight into the natural laws and physical principles underlying the production, transmission, and use of compressed air. Examples for practice are interspersed among the reading matter for the use of the student. Practically all of the modern types of air compressors are illustrated and the characteristics of each discussed. An appendix is also given of tabulated data for the assistance of the reader in making quick calculations.

Recent Publications

Rocky Mountain Mine Timbers. By Norman de W. Betts. Professional paper from the Forest Service, Bulletin 77. Page 34. Illustrated. U. S. Department of Agriculture, Washington, 1914. This is an interesting discussion for mining men.

Government Ownership of Railways. List of publications pertaining to Bulletin 62. P. 74. Index of authors. Bureau of Railway Economics, Washington, 1914. This is a subject causing considerable discussion of late, and publications on the world's systems are abstracted.

Screen-Scale Sieves Made to a Fixed Ratio. By G. A. Disbro. Reprint from *Proceedings* of the American Society for Testing Materials. P. 16. Illustrated. Philadelphia, 1913. The size of opening, the clear space between the wires, and not the mesh, directly determines the size of product that will pass a testing sieve. Mr. Disbro discusses the whole question of screens.

Coal in Alaska. Report on, for the use in United States Navy. A letter from the Secretary of the Navy dealing with surveys, and experimental tests on the coal on warships. P. 123. Maps and 12 plates. Washington, 1914. The conclusion is arrived at, that the failure on test of the excellent Bering River sample at the Engineering Experiment Station from severe and unusual clinkering, a sample better in all respects than the Pochahontas used in comparative test, obliges the department to regard and so report the Bering River field to be unavailable as a source of coal for the Navy, until extensive general development definitely locates coal not possessing the serious objection found in the sample tested by the department.

U. S. Geological Survey publications. Washington, 1914:
'Minerals Resources of the United States, 1913':

Production of Chromic Iron Ore, 1913. By J. S. Diller. P. 13. Ill.

Production of Bauxite and Aluminum, 1913. By W. C. Phalen. P. 29. Ill.

Production of Sand-Lime Brick, 1913. By Jefferson Middleton. P. 8.

Production of Mica, 1913. By Douglas B. Sterrett. P. 11.

U. S. Bureau of Mines publications:

Procedure for Establishing a List of Permissible Portable Electric Mine Lamps. Fees, character of tests, and conditions under which lamps will be tested. Schedule 6. P. 12.

Problems of the Petroleum Industry. Results of conferences at Pittsburgh, August 1 and September 10, 1913. By Irving C. Allen. Technical paper 72. Petroleum technology 17. P. 19.

Physical and Chemical Properties of the Petroleums of California. By Irving C. Allen, Walter A. Jacobs, A. S. Crossfield and R. R. Matthews. Technical paper 74. Petroleum technology 18. P. 38. Illustrated. Methods of sampling oil by the Bureau officials, refining, and tabulation of results are given, of value to oil men everywhere.

Safety and Efficiency in Mine Tunneling. By David W. Brunton and John A. Davis. Bulletin 57. P. 271. Ill., index. This is a valuable discussion and should be in the hands of all tunnel engineers, especially for comparative purposes. It covers American tunnels described in engineering magazines, causes of accidents (falls of roof and explosives), prevention of accidents, surface equipment for driving tunnels, power required, ventilation, drilling machines, underground haulage, drilling, blasting, costs of tunneling, history of tunneling, and rate of progress, and cost of railway tunnels. There is also a bibliography, and a well selected collection of illustrations.

Water-Supply Papers:

Stream-Gaging Stations and Publications Relating to Water Resources, 1885-1913. Part I. North Atlantic Coast drainage basins. Compiled by B. D. Wood. No. 340-A. P. 31.

Ground-Water for Irrigation in the Vicinity of Wichita, Kansas. By O. E. Meinzer. Preliminary report. No. 345-A. P. 9.

Ground-Water for Irrigation in the Vicinity of Enid, Oklahoma. By A. T. Schwennesen; with a note on Ground-Water for Irrigation on the Great Plains, by O. E. Meinzer. No. 345-B. P. 13. Map.

Underground Water of Luna County, New Mexico. By N. H. Darton, with Results of Pumping Tests, by A. T. Schwennesen. No. 345-C. P. 16. Map.

Ground-Water for Irrigation in the Valley of North Fork of Canadian River, near Oklahoma City, Oklahoma. By A. T. Schwennesen. No. 345-D. P. 11. Map.

Surface Water of the United States, 1911. Part VI. Missouri River Basin. Prepared under the direction of M. O. Leighton by W. A. Lamb, W. B. Freeman, and Raymond Richards. No. 306. P. 374. Map, index.

Surface Water Supply of the United States, 1911. Part IX. Colorado River Basin. By Robert Follansbee, W. B. Freeman, and G. Clyde Baldwin. No. 309. P. 266. Map, index.

Surface Water Supply of the United States, 1912. Part II. South Atlantic coast and eastern Gulf of Mexico basins. By W. E. Hall and C. H. Pierce. No. 322. P. 98. Ill., map, index.

Surface Water Supply of the United States, 1912. Part IV. St. Lawrence River Basin. By C. C. Covert. A. H. Horton and W. G. Hoyt. No. 324. P. 149. Ill., index.

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Construction News Summary

Petroleum

A proposal to merge the companies comprising the Independent Oil Producers' Agency into a single organization is well under way. The matter was submitted to the members of the Agency at the annual meeting held in Bakersfield on June 17, at which more than half the membership was represented. The executive committee was authorized to expend $30,000 for an appraisement of the various properties concerned. This work will take approximately six months. The Agency controls the production of about 16,000,000 bbl. of oil per year, nearly all of which is of low gravity. Among the benefits to be derived from the proposed consolidation are the elimination of the heavy overhead expense now being borne by individual companies, and the opportunity to perfect transportation, refining, and marketing facilities, thereby conserving to the members a large proportion of the profits possible in oil production.——A list of producers of gasoline from casing-head gas in the state of California compiled by the *Oil and Gas Journal* is as follows:

Name and Location.	Gallons per day.
Puente Oil Co., Puente field	400
Pacific Gasoline Co., Brea Cañon (two plants)	4,000
Union Oil Co., Santa Maria (two plants)	3,000
Standard Oil Co., Newhall	400
Standard Oil Co., Coyote Hills	800
American Gas Co., Santa Maria	1,400
Purity Gasoline Co., Santa Maria	1,000
Rice Ranch Oil Co., Santa Maria	800
Pinal Dome Oil Co., Santa Maria	2,500
Frank Hall, Santa Maria	500
Olinda Gasoline Co., Olinda	1,100
Hurley, Smith & Collins, Oleo	2,000
*A. F. Gilmore, Salt Lake field	1,025
Montebello Oil Co., Fillmore	800
Turner Oil Co., Coalinga	2,000
Total	21,725

*Seven hundred gallons of the Gilmore production comes from a 'sweating' or fumes process from boiling oil, and is of a much lower grade than the casing-head article.

It is stated that the Rice Ranch Oil Co., at Santa Maria, will install machinery to increase its gasoline production to 2000 gal. per day.

The following are recent new incorporations of oil companies:

The Visalia Oil Co., which was incorporated under the laws of this state some time ago, has taken over the property of the Visalia Non-Assessable Oil Co., an Arizona corporation. The new Company has a capitalization of 100,000 shares with a par value of $1. The stockholders in the old Company have exchanged their shares for stock in the new concern, and all the property and accounts of the Non-Assessable company have been transferred to the recently organized corporation. When the transfer was effected the old Non-Assessable company ceased to exist. The new Visalia company will hold title to the southwest quarter of Sec. 14, 32-23, in the Midway field. The north half of this property is at present under lease to the Union Oil Co. The directors of the Visalia Oil Co. are: Louis Lucier, president; Charles G. Lamberson, vice-president; Otto Luhdorff, secretary; M. S. Featherstone, Frank Lamberson, L. C. Hyde, and W. D. Green. All of the directors are residents of Visalia, where the headquarters of the Company are.

The Virginia Oil Co. of Los Angeles has been incorporated with a capitalization of 25,000 shares with a par value of $1. The directors are G. G. Tibbens, J. F. Millikin, Herbert L. McNair, Wilfred M. Peck, and E. E. Hellyer, all of Los Angeles.

Articles of incorporation have been filed with the Secretary of State for the Pittsburg Pacific Oil Co. of Los Angeles. The Company is capitalized at $1,000,000, and the par value of shares is $1. The directors are Gordon Errett, R. R. Thomas, R. A. Forbes, E. A. Lane, and F. B. Curtiss, all of Los Angeles.

According to the *Standard Oil Bulletin*, the production of Petroleum in California established a new record in May. The daily average was 297,466 bbl., as against 286,591 bbl. in March. Shipments fell off, the daily surplus increasing to 22,337 bbl. A summary of field operations follows:

Field.	New rigs	Drilling	Wells completed	Wells abandoned	Producing	Production per day
Kern River	..	10	3	..	1431	20,395
McKittrick	2	3	2	1	250	9,741
Midway-Sunset	22	84	27	1	1367	147,118
Lost Hills-Belridge	7	12	8	2	224	13,244
Coalinga	..	32	3	..	859	44,158
Lompoc and Santa Maria	1	13	..	..	236	12,255
Ventura County and Newhall.	5	30	6	..	411	2,905
Los Angeles and Salt Lake	..	6	..	..	681	6,984
Whittier-Fullerton	10	83	8	..	525	40,438
Summerland	..	...	..	..	108	153
Watsonville	..	...	..	..	5	75
Salinas Valley	..	...	..	..	....	.....
Total	47	273	57	4	6097	297,466

Total crude oil stocks May 31, 1914, 50,318,025 bbl. Total shipments from fields May 1914, 8,528,995 barrels.

Salt Lake City, Utah.—The sale has been announced of all of the properties of the Utah Wyoming Consolidated Oil Co., of Utah, to the Byron Oil & Gas Co. at Byron, Wyoming. The consideration is said to have been approximately $4,000,000.

Streets and Roads

Riverside, Cal.—A new road between Riverside and Crestmore by Fairmount park is to be built through the coöperation of the city, county, Riverside Portland Cement Co., and the Crescent City Railroad Company.

Santa Barbara, Cal.—The City Council has passed a resolution to pave Valerio street.

Tulare, Cal.—Petitions have been filed with the supervisors asking for a special election for the purpose of voting $1,000,000 bonds for new roads. The City Trustees have passed a resolution providing for paving a number of city streets.

Palo Alto, Cal.—The City Council has awarded a contract to the Federal Construction Co. for paving Middlefield road, Forest, Kingsley, and Melville avenues.

Richmond, Cal.—The City Council has decided that bitulithic top coat with a 6-in. portland cement concrete base will be used for paving Twenty-third street.

Vallejo, Cal.—The City Council has directed Laurence Thompson, city engineer, to prepare plans for a board walk and an 80-ft. driveway.

Stockton, Cal.—Bids will be received by the clerk of the Board of Supervisors until 10 a.m., July 7, for oiling certain county roads near Manteca, Lathrop, and Ripon, a total distance of 9 miles.

Oroville, Cal.—The City Council has let a contract for paving 14 blocks of street to the Clark & Henery Construction

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Co., of San Francisco, at a price of $36,352.50. Other bids were: Municipal Improvement Co., $37,344.50; Ransome-Crummey Co., $37,871.50; and McGillivray Construction Co., $39,432.50.

Sacramento, Cal.—The City Commission has passed a resolution of intention to pave a number of streets with a 4-in. cement concrete base and a ½-in. sheet asphalt wearing surface. J. C. Nurse is superintendent of streets.——The State Engineering Advisory Board has approved the bid of P. L. Burr, of San Francisco, to construct a section of the state highway from Lindo channel north of Chico to the Tehama county boundary line at a price of $55,612.——Resolution of intention has been passed by the State Commission to improve certain sections of the California boulevard by constructing concrete curbing, concrete catch-basins with cast iron curbing and cover, cast iron gutter drains, and vitrified sewer-pipe drains.——Bids have been received for certain sections of the state highway as follows:

Shasta county: Division II, Route 3, Section D—F. Rolandi, San Francisco, $63,245; Berry, Mackie & Co., San Francisco, $64,770; P. L. Burr, San Francisco, $76,925.

Glenn county: Division III, Route 7, Section C—F. Rolandi, San Francisco, $44,983; Carnahan & Mulford, San Francisco, $38,102; P. L. Burr, San Francisco, $39,035; M. Jacinto, Sacramento, $40,146; P. H. Hoare, Oakland, $37,-209.50; Fred Leffler, San Francisco, $47,783.60; M. Blumenkranz, Stockton, $39,822.60.

Butte county: Division III, Route 3, Section D—P. L. Burr, San Francisco, $55,612.95; Chico Construction Co., Chico, $58,512.40.

Tehama county: Division II, Route 7, Section A—F. Rolandi, San Francisco, $64,686.90; Carnahan & Mulford, San Francisco, $62,210; P. L. Burr, San Francisco, $59,333.90; M. Jacinto, Sacramento, $53,679.40.

The following contracts for road construction for the state highway have been awarded:

Sonoma county, from Cloverdale to the northerly boundary line, Hard Bros., Sacramento, $38,699.20.

Marin county, Larkspur to Sausalito, 6 miles, O'Brien Bros., Oakland, $53,395.

Merced county, running 14 miles from Merced south, Taylor & Berliner, Los Angeles, $51,350.

Kern county, from Bakersfield south, 13 miles, John D. Marsh, Los Angeles, $72,282.70.

Siskiyou county, Hornbrook north to Oregon state line, 8 miles, W. H. Mason, Klamath Falls, and F. T. Fradenburgh, Hornbrook, $29,514.

Bids received for road building in Tuolumne county were thrown out, all being in excess of the engineer's estimate. The lowest bid was $55,730, and the estimate $46,684.

Bids have been called until 11 a.m., July 6, for certain sections of the state highway as follows:

Tehama county, from the south boundary to Los Molinos, about 10.6 miles, of portland cement concrete.

Yolo county, from the southerly boundary to Woodland, about 11.7 miles, of portland cement concrete.

Santa Cruz county, from Glenwood to Santa Cruz, about 10.3 miles, to be graded.

Santa Barbara county, from Orcutt to Santa Maria, about 6.5 miles, of portland cement concrete with asphaltic wearing surface.

San Benito county, from San Juan Bautista to the northerly boundary, about 4 miles, of portland cement concrete.

Until 2 p.m., July 6, 1914:

Shasta county, from Bayha to the Sacramento river, about 16.2 miles, to be graded.

San Luis Obispo county, from Arroyo Grande to San Luis Obispo, about 13.4 miles, of portland cement concrete.

Kern county, from Grape Vine creek to Sec. 5 and 6, T. 32 S., R. 28 E., M. D. B. & M., about 17.3 miles, of portland cement concrete.

Ventura county, from Newbury Park to Springville, about 11.1 miles, of portland cement concrete.

San Diego county, from La Mesa to El Cajon, 1.6 miles, of portland cement concrete.

Portland, Ore.—The County Commissioners have filed resolution of intention for road improvement No. 580, known as the base-line road from the east boundary of the city to the west line of road No. 533. Warrenite is to be used. John B. Coffey is county clerk.——Bids have been received for improving certain sections of East Davis, East Ash, East Eighty-third, East Eighty-fourth, East Eighty-fifth, East Eighty-sixth, and East Eighty-seventh streets, Beryl terrace and Billingher drive, as follows: G. K. Howitt, $34,290.35; Keenan Bros. Co., $36,350.25; Joplin & Meeks, $36,433.95; O. M. Patton, $31,498.60; Manning & Co., $33,836.45; M. Hanson, $34,109.51; Cochran, Nutting & Co., $32,956.88; Jeffery & Bufton, $37,-434.90; Elliott Contracting Co., $38,202.86.

Medford, Ore.—The convention of the Tri-State Good Roads Association will be held here July 27 and 28.

North Yakima, Wash.—Contract for constructing 1⅛ miles of water-bound macadam state road from the east end of Yakima avenue bridge to Terrace Heights has been awarded to Anderson & McKivor for $5950.

Olympia, Wash.—Contract has been awarded for paving lower Main street with 2-course concrete to Albers & Son, of Chehalis, for $7827.54.——State Highway Commission has awarded a contract to Mitchell Bros., of Spokane, for constructing 8.3 miles of the Inland Empire highway in Whitman county, from Colfax to Steptoe, at a price of $27,685.

Walla Walla, Wash.—The County Commissioners have awarded a contract to Henry Benzel for a 4-mile section of gravel macadam road for the Inland Empire highway south of Waitsburg for $14,987. L. W. Loehr is county engineer.

Ritzville, Wash.—Zanes & Co., of Hanford, have been awarded a contract to construct 7 miles of highway from Ralston to Ritzville at a price of $35,000.

Ellensburg, Wash.—E. L. Ferrier has been awarded a contract for building concrete cement sidewalks on 34 city blocks at a price of $9118.

Newport, Wash.—The County Commissioners have let a contract for 6800 ft. of highway connecting the towns of Usk and Cusick to J. W. Hastings, of Spokane, for $7851. The road will be made of gravel, 16 ft. wide.

Colville, Wash.—The County Commissioners have awarded a contract for 4 miles of Springdale-Hunters highway to H. W. Silke and Paul La Plant for $15,334.

Spokane, Wash.—A contract has been awarded to the Spokane Bitu-mass Paving Co. for macadamizing a 5-mile section of Palouse highway between Waverly and Spring Valley at a price of $23,750. Other bids were: Mitchell Bros., $23,980; Salisbury & Nelson, $24,879; W. G. Mulligan, $25,998; and J. W. Hastings, $32,500.

Irrigation and Water Supply

Santa Cruz, Cal.—The City Council has passed a resolution for an election to authorize a bond issue of $150,000 to provide funds for the construction of new water mains, storage reservoir, and other water supply improvements.

Modesto, Cal.—The Dry Creek irrigation district has been authorized by land-owners near this city, by order of the Board of Supervisors of Stanislaus county. H. Benson is clerk of the board.

Needles, Cal.—The Murphy Water, Ice & Light Co. is going to make a number of extensions to the city water mains.

Porterville, Cal.—Contract has been executed between the City Council and the Pease-Bundy-Taylor Co., of this city, for the installation of pumping machinery for the Third-street plant.

Richmond, Cal.—An election is to be held on July 22 to authorize a bond issue of $2,500,000 for city water supply.

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Sacramento, Cal.—The State Reclamation Board has levied an assessment of $250,000 which will be apportioned to the holdings within the Sacramento and San Joaquin drainage district, which embraces 175,000,000 acres.——The approval of a private reclamation district of 800 acres in San Joaquin near the Alameda county line owned by Messrs. Lammers, Mournain, and Lindermann, has been asked.——Arrangements have been made with the Sutter Basin Improvement Co. for the purchase of rights-of-way for the by-pass from Nelson's bend to the Tisdale weir, paying therefor at the rate of $20 per acre for easement and $50 for fee for the lands underlying the levee and borrow pit. Forty-eight hundred acres will be required for this purpose.

Red Bluff, Cal.—Test pits being sunk by county surveyor Luning for the purpose of determining the character of the foundation for the Iron Cañon dam show solid rock down to a depth of 43 feet.

Montague, Cal.—Two new projects are being developed by the Montague Land & Irrigation Co. and the Mount Shasta Land & Irrigation Co. The project of the former embraces 5000 acres near Montague. Water is taken from the Shasta river and pumped to a main ditch line. The latter includes 15,000 acres southeast of Montague, the water being pumped from Big Springs and delivered through two main canals.

Edgemont, Cal.—A project is under way to reclaim 8000 acres of land and place it under irrigation. B. J. Bennett is promoting the scheme.

Springfield, Ore.—The Oregon Power Co., of Portland, is undertaking improvements to the city water system at a cost of $6000. W. T. McCulloch is in charge of the work.

Klamath Falls, Ore.—It is stated that the Modoc Point irrigation project will be completed this fall. H. W. Hincks is project engineer.

North Yakima, Wash.—The U. S. Department of the Interior has approved contract between the water users of the Sunnyside irrigation district and the Reclamation Service. Contract provides for the acceptance by the Government of 20-year 6% district bonds at 90c. Surveys are complete and as soon as the bonds are sold the Reclamation Service will call for bids on the construction.——The United States Government is making surveys to establish reservoirs on the Simcoe, Satus, and Dry creeks for the purpose of irrigating 55,000 acres not included in the Wapato project. It is also proposed to develop power on the Wapato project for pumping water and for irrigating an additional 10,000 acres. L. M. Holt is superintendent of irrigation for the U. S. Indian Service.

Miscellaneous Engineering Construction

South Pasadena, Cal.—The following bids have been opened by the City Council for motor-driven fire engines: Ahrens-Fox company, 6-cylinder, $10,000; Hale company, 6-cylinder, 90-hp., $8500; Seagrave company, 4-cylinder, 96-hp., $9750; Seagrave company, 6-cylinder, 144 hp., $10,750; Robinson company, 4-cylinder, 80 hp., $8500; Robinson company, 6-cylinder, 110 hp., $9000; American La France, 4-cylinder, 48-70 hp., $9000; American La France, 4-cylinder, 48-70 hp., $8000; American La France, 6-cylinder, 72-100 hp., $9000; James Boyd & Son, 4-cylinder, 49 hp., $7500; James Boyd & Son, 6-cylinder, 80 hp., $8600; Nott Engine Co., 6-cylinder, 72-100 hp., $9750; Knox Auto Co., 6-cylinder, 90 hp., $8300 without chemical apparatus, and another bid from the same firm with chemical apparatus, $9175.

Madera, Cal.—Contract for building the new bridge over the Chowchilla river on the Raymond-Mariposa road was awarded to J. Willison for $6142.

Fresno, Cal.—Bids will be received at 8 p.m. on July 6 by the Board of Trustees for a combined mixer and heater for bituminous road mixtures, 10 cu. ft. per batch capacity, with a 6-hp. steam-engine and a 12-hp. boiler. W. H. Ryan is city clerk.——Bids will be received by the Board of Trustees July 6, at 8 p.m., for motor-driven hose wagon and motorization of three horse-drawn wagons.——Additions to the machine and woodworking shops of the Fresno High School are to be made at a cost of $25,000.

Santa Barbara, Cal.—Bids will be received until 10 a.m., July 6, for constructing a Pratt truss bridge over the Maria Ygnacio creek on the San Marcos pass road. C. A. Hunt is county clerk.

Turlock, Cal.—A bond issue of $15,000 has been approved to provide funds for new fire apparatus, including a fire-alarm system. The funds are to be apportioned as follows: Standard fire-alarm system consisting of not less than 25 boxes, $5000; an alternating fire-bell tower, with electrical bell striker, $1000; a combination motor-driven hose and chemical truck, $6500; repairs to the engine-house and incidentals, $1900.

Modesto, Cal.—The supervisors have accepted plans prepared by Edgar Annear, county surveyor, for three bridges and a culvert. Bids will be opened on July 14.——It is proposed that a bridge be constructed jointly of reinforced concrete over Lateral No. 4 at the north end of Ninth street by the city and the Modesto irrigation district. C. S. Abbott is secretary for the district and is ready for bids.——Bids are called for the construction of a new stairway on the north and south sides of the courthouse. H. Benson is clerk for the Board of Supervisors.

Stockton, Cal.—The Commercial & Savings Bank of Stockton has called for bids for all work for their new bank buildings to be erected on the corner of Main and Sutter streets.

San Jose, Cal.—Bids will be received up to 11 a.m., July 20, by the Board of Supervisors for the construction of a reinforced concrete extension to the bridge over Llagas creek on San Martin avenue. Henry A. Pfister is clerk.——Bids will be received up to 11 a.m., July 20, for the construction of a steel highway bridge over Pacheco creek between San Benito and Santa Clara counties by the Board of Supervisors. Henry M. Ayer is chairman of the board.

San Francisco, Cal.—Plans and specifications for the superstructure of pier 39 have been approved by the Board of State Harbor Commissioners. Plan calls for a two-story, steel-frame concrete structure 104 ft. wide, 900 ft. long.——Plans and specifications have been approved for the construction of pier 37, foot of Kearny street. This is to be a creosoted pile structure, 200 ft. wide by 831 ft. long, on the northerly side, and 1060 ft. long on the southerly side, and is to have a reinforced-concrete bulkhead.——The Valley Pipe-Line Co. has placed an order for a pipe-line 172 miles long with the Youngstown Sheet & Tube Co. of Youngstown, Ohio.

Berkeley, Cal.—A bond issue is proposed to provide $1,175,000 for the construction of five new schools, a civic centre, improvement of the waterfront, dredging, and wharf construction. J. J. Jessup is city engineer.

Richmond, Cal.—A contract has been let by the city to Moffett & Mead, of Oakland, for completing the final portion of the municipal highway from the tunnel at a price of $75,000.——The City Council has decided to use reinforced-concrete piles for the 740-ft. municipal wharf.——Bonds to the amount of $75,000 to provide funds for new sewers have been sold.

Vallejo, Cal.—The following bids for a hopper dredge have been opened: Moran company, Seattle, $295,000; Mare Island Navy Yard, $293,000; Union Iron Works Co., $247,000; New York Shipbuilding Co., $240,000; and the Skinner Dry Dock & Construction Co., of Baltimore, $205,000.

Dixon, Cal.—A bond issue has been voted to provide $60,000 for the construction of a new high school building.

Sacramento, Cal.—Bids have been received for the construction of a reinforced concrete and timber trestle across the Yolo by-pass. The estimated cost is $363,800.12, of which amount $215,634.06 is to be used for labor, cement, and other

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materials. Steel and asphalt aggregating $148,166.06, which was not included in the bids, is to be furnished by the state.

Grant Fee, San Francisco, engineer's plans, $296,461.30; alternative plans, $269,410.20. Grant Fee, San Francisco; alternative plans, $279,105.90; Brayton Engineering Co., Portland, Ore., alternative plans, $397,069.60. Leonardt & Mesmer, Los Angeles, engineer's plans, $214,648.35; alternative plans, $331,793.70. San Francisco Bridge Co., San Francisco, engineer's plans, $328,435.55; alternative plans, $246,060.52. Van Sant-Houghton company, San Francisco, engineer's plans, $250,415.30; alternative plans, $247,206.25. Van Sant-Houghton company, San Francisco, alternative plans, $248,175.92; Sound Construction & Engineering Co., San Francisco, engineer's plans, $257,836; alternative plans, $238,823.82. Snare & Triest company, New York, engineer's plans, $387,340.10.

The City Commission has authorized the construction of a two-story concrete wharf immediately south of the M-street bridge. The California Transportation Co. will build the wharf at a cost of $5000. The work will be under the direct supervision of Albert Givan, city engineer.——Plans are being drawn for an auditorium building to be erected at the northeast corner of Tenth and L streets. A. M. Mull is owner.——The city of Sacramento is to commence the construction of a sewage pumping plant which will have a capacity of 144,000,000 gal. per day.

Woodland, Cal.—The Yolo County Supervisors have passed a resolution providing $35,000 for the construction of a concrete bridge across Cache creek, north of Esparto. Another bridge is under consideration across Putah creek, east of Winters, and one across Cache creek near Yolo.

Roseville, Cal.—A bond issue of $45,000 for the new Union High School has been carried.

Yreka, Cal.—Bids will be received until 10 a.m., July 7, by W. J. Neilon, county clerk, for the construction of a 140-ft. span steel truss bridge over the Scott river.

Auburn, Cal.—A new school building is to be erected at a cost of $47,000. Bonds for this purpose were voted on June 16.

Red Bluff, Cal.—The State Engineering Department is about to commence the construction of a reinforced concrete bridge at Salt creek and a steel bridge with concrete piers at Mad river and at Trinity river.

Oroville, Cal.—Bids have been called up to July 7, at 2 p.m., for the construction of a reinforced concrete bridge across North Honcut creek on the Oroville and Bangor road. C. F. Belding is county clerk.

Chico, Cal.—The following bids have been received at Washington, D. C., for the new United States public building: J. B. Reit, of San Francisco, $70,620; B. J. Duffy, Dorris, $76,230.

Yuba City, Cal.—Plans and specifications for a reinforced concrete bridge over Butte slough have been accepted by the Board of Supervisors. E. L. Cope, of this city, is the designer. The estimated cost is $60,000.

Ashland, Ore.—The people have voted a bond issue of $175,000 for the development of mineral springs.

Portland, Ore.—The State Highway Commission has called for bids for constructing two steel spans near the railway station at Houlton, Columbia county. For information, address the Commission at St. Helens, Oregon, or 422 Court House, Portland. H. L. Bowlby is state highway engineer.

Walla Walla, Wash.—The County Commissioners have retained E. B. Shifley to prepare plans and specifications for a new bridge across the Touchet river, 4½ miles west of Prescott.

Seattle, Wash.—The Snowqualmie Falls Lumber Co. has just been organized with a capital stock of $3,000,000. It is a consolidation of the Grandin Coast Lumber Co. and Weyerhaeuser interests to operate in the Snowqualmie district. A sawmill plant will be built on or before September 1. The incorporators are: George S. Long, of Tacoma, executive officer of the Weyerhaeuser interests; O. D. Fisher, of the Fisher Mills, Seattle; and W. D. McCormick. In the incorporation papers, John P. Weyerhaeuser and G. W. Grandin are designated as trustees.——Plans and specifications have been received by the executive committee of the Seattle Masonic Temple for a new masonic temple to be erected at a cost of about $125,000.

Chehalis, Wash.—C. A. and J. C. Butler, of Ballard, will erect a shingle mill at Mays with a capacity of 90,000 shingles per day.

Vancouver, Wash.—The Supreme Court has passed upon the legality of the Clark county bonds for $500,000 which will be used to provide funds for the erection of the Columbia river interstate bridge.

Centralia, Wash.—The Centralia Wood Preserving Co. will erect a plant at this city in July. W. B. Richards, Jesse McElfresh, and W. D. Foss, of this city, are interested.

Spokane, Wash.—A franchise has been granted to the Trustee Co. by the City Council for 25 years to furnish water, steam heating, electric lighting, and power. H. A. Flood is president of the Company and R. F. Hanke is secretary. The franchise requires that the work of installation commence within a year and that the Company must invest not less than $100,000.——Three plans have been submitted to the City Council by the city engineer, Morton Macartney, for downtown sewers as follows: First plan, a complete intercepting sewer, reinforced concrete, 6½ ft. diameter, costing $160,000, and entering river near Stadium site; second plan, same as the first, except that sewer will enter river east of Monroe-street bridge, costing $112,500; third plan contemplates only building outlet from Main avenue and Lincoln street to river, costing $16,000.

Power, Gas and Electricity

San Francisco, Cal.—Under the authorization of the Railroad Commission, the Coachella Valley Ice & Electric Co. will erect a transmission line between Banning, Riverside county, and El Centro, Imperial county, tapping the transmission line of the Southern Sierra Power Co. at Banning.——The Long Beach Consolidated Gas Co. has been authorized to issue $60,000 in bonds and $140,000 in stock for the retirement of promissory notes and liquidation of other obligations.

San Jose, Cal.—The Willow Glenn lighting district has been formed. Seventy electroliers will be installed. C. W. Cutler, Edgar Foote, and C. W. Null are interested.

Placerville, Cal.—The Western States Gas & Electric Co. is preparing to expend $50,000 for enlarging flume and installing another generator.

Fall River Mills, Cal.—The California Power & Mfg. Co. is commencing the construction of a 400-hp. hydro-electric powerplant. Charles E. Kornel is general manager in charge of the work.

Railways

Fresno, Cal.—Work has commenced ballasting the roadbed for the Fresno interurban railroad.

San Jose, Cal.—The Board of Supervisors has under consideration an ordinance granting a 50-year franchise to the San Jose railroads for construction of a standard-gauge single or double-track car-line from the city limits to Kirk avenue.

Riverside, Cal.—It is stated that the Santa Fe Railroad Co. is contemplating the construction of a connecting link between Corona and Elsinore.

Benicia, Cal.—The Benicia Land & Terminal Co., of which J. R. Cunningham is manager, has announced that construction work will commence on the Vallejo and Benicia electric railroad within a few weeks.

San Francisco, Cal.—Authority to issue $120,000 in bonds and $60,000 in stock has been granted by the California Railroad Commission to the Fresno Interurban Railroad Co.——

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The Board of Public Works has awarded a contract for furnishing and installing overhead electric conductors for the municipal railway to H. S. Tittle for $36,245.——It is stated that George C. Moore, who has recently acquired controlling interest in the San Francisco-Oakland Terminal Railways, has undertaken to finance a new electric road between San Francisco, Oakland, and San Jose *via* Hayward and Bay Farm Island. The terms of his agreement with W. S. Tevis and R. G. Hanford provide that construction work must commence by March 1, 1915, and be completed in one year. A pier and ferry connecting the road with Bay Farm Island are to be constructed.

Sacramento, Cal.—Articles of incorporation have been filed with the Secretary of State for the Southwestern Pacific Railroad, which is to be built from Denver to San Diego. Authorized capital stock is $2,200,000. Estimated cost will be $105,000,000, and the length will be about 2200 miles. The officers, directors, and stockholders are as follows: D. C. Collier, of San Diego, president; Herbert A. Parkyn, of Chicago, first vice-president; August H. Bunge, of Chicago, second vice-president; Samuel S. Sherman, Chicago, secretary and treasurer; C. C. Carnahan, Chicago, general counsel; J. E. Carnahan, Canton, Ohio; H. B. Rettie, Chicago; Ed. Fletcher, San Diego, and Thomas Morinaux, Salt Lake City, directors.

Oakland, Cal.—The San Francisco-Oakland Terminal Railways will commence work immediately on reconstructing the Company's roadbed on Twelfth street from Lake Merritt to Jefferson street. 'V' girder rails will be set upon concrete sub-grade.

Portland, Ore.—Contract has been let to Twohy Bros., of this city, for the construction of the Oregon-Washington Railroad & Navigation Co.'s line to Olympia at a cost of $500,000.

Personal

WILLIAM MEEK is city engineer at Marysville.

GEORGE S. YOUNG is city engineer at Bend, Ore.

J. X. GARDNER, chief engineer for the New Castle irrigation project, was in Salt Lake City recently.

FREDERICK W. HUBER, consulting chemical engineer of Los Angeles, is touring the cities on the Atlantic coast.

WILLIAM H. STORMS is investigating the Mount Lassen volcano in behalf of some San Francisco newspapers.

JOHN NOLEN of Boston has been retained by the Sacramento City Commission to devise a plan of city development.

J. S. DILLER has been investigating the Mount Lassen volcano disturbance on behalf of the U. S. Geological Survey.

A. B. VANCE, of the California Portland Cement Co., Los Angeles, spent a few days in San Francisco en route to Tacoma.

H. O. BROWN, chief engineer for the Northern Electric Railway Co., has been on an inspection trip over the Company's lines.

W. S. MCCLURE, state engineer for California, has been inspecting irrigation districts in the vicinity of Modesto and Turlock.

RAMSEY M. COX, of Waco, Texas, has been appointed general manager for the Nevada-California-Oregon railroad, with headquarters at Reno.

W. D. BEERS, state engineer for Utah, and JOSEPH JENSON, assistant state engineer, have been inspecting the Otter creek dam near Coyote, Utah.

L. D. ALBIN, assistant general sales manager for the Ingersoll-Rand Co. of New York has returned after a three month's trip to the Pacific coast.

W. C. EDES and LIEUTENANT MEARS, U. S. A., of the Alaskan Railway Commission were entertained by the Engineers' Club of Seattle at luncheon on June 4.

G. B. HEGARDT, chief engineer for the Commission of Public Docks at Portland, Oregon, has been testing the municipal boat landing at Stark street.

PAUL R. GOPPOLDT and RICHARD HALL have opened offices for the general practice of civil engineering at Victorville, San Bernardino county, Cal.

A. E. CHANDLER, ALEX BROWN and MAX W. ENDERLEIN have been appointed assessors for the State Reclamation Board with headquarters at Sacramento.

E. MCCULLOCH, engineer for the U. S. Reclamation Service, is in charge of the surveys and investigating party for the Palouse irrigation project near Colfax, Idaho.

COLIN CAMPBELL RAE has resigned his position as geologist for the General Petroleum Co. to become general manager for the Henry Crum Oil interests at Cody, Wyoming.

BION J. ARNOLD, consulting engineer of Chicago, has been in San Francisco in connection with the inspection and appraisal of the Oakland, Antioch & Eastern Railroad.

E. A. QUINN, formerly of the San Francisco office of the Allis-Chalmers Co., has been appointed general superintendent of the San Joaquin Light & Power Co., with headquarters at Fresno.

HAROLD ALMERT, consulting engineer of Chicago, Illinois, has been retained as technical counsel by the Washington Railway & Electric Co. and the Potomac Electric Power Co. of Washington, D. C.

WILLIAM C. SARGENT, vice-president of the Chain Belt Co. of Milwaukee, has recently visited the Pacific Coast to confer with Meese & Gottfried Co. and the A. L. Young Machinery Co., their local agents.

J. SCHULZ, 312 Wright & Callender building, has been retained by the city of Long Beach to prepare plans for the Devil's Gate reinforced concrete pleasure pier, which is to be built at a cost of $50,000.

I. S. VOORHEES, engineer for the U. S. Reclamation Service at Klamath Falls has accepted a transfer to the Umatilla project to take charge of construction of the new dam to be built across the Umatilla river.

F. G. COTTRELL, in charge of the western division of the U. S. Bureau of Mines, delivered a lecture under the auspices of the Utah Society of Engineers at Salt Lake City on the process of smelter smoke control.

G. A. REICHARD, of the Los Angeles office of the International Steam Pump Co. will sail from San Francisco July 11 on the Pacific Mail Steamship *Manchuria* for a four month's business trip to Japan, China, and the Philippines.

IRA P. ENGLEHART of North Yakima, Washington, and E. F. BENSON of Tacoma have been appointed by the Governor as members of the irrigation commission provided for at the Irrigation Conference in Denver last April.

JOEL PRIEST, of Caldwell, Idaho, together with J. M. THOMPSON of Caldwell, E. M. KIRKPATRICK of Parma, and B. M. HOLT of Caldwell, have been at Washington, D. C., in the interest of the Black Cañon irrigation project of Idaho.

EDWIN DURYEA, JR., consulting engineer of San Francisco, has been retained as consulting engineer to the San Diego Board of Water Commissioners with reference to improvements to be carried out under the recent $1,000,000 bond issue.

C. L. CORY, consulting engineer of San Francisco, was awarded the degree of Doctor of Engineering on the 25th anniversary of his commencement at Purdue University. Dr. Cory is the third to whom this honor has been conferred by Purdue, the others having been ELWOOD MEADE and ANGUS SINCLAIR.

Sir WILLIAM WILLCOCKS, K.C.M.G., designer of the famous Assuan dam, has been inspecting Western irrigation projects as consulting engineer for the Secretary of the Navy, accompanied by W. M. CODE, formerly chief engineer for the Indian Service; D. W. MURPHY, formerly drainage engineer; and L. C. HILL, formerly supervising engineer for the U. S. Reclamation Service.

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Commercial Paragraphs

R. F. Ware, of Los Angeles, contractor for ditching, has established a San Francisco office at 423 Balboa building, telephone Kearny 5327.

Crocker-Wheeler Company announces the removal of its San Francisco district office from First National Bank building to Crossley building, 618 Mission street.

Kawneer Mfg. Co. has completed a branch factory at West Berkeley, California, for the manufacture of store fronts and other modern means for merchandise display.

Wrightson, Anderson & Yost, contractors of Sacramento, are using Briggs' tip-over carts on the construction of the Half Moon Bay-Montara road in San Mateo county.

Grant Gravel Co., owing to a large increase in business, has taken more commodious offices in the Flatiron building, corner Market, Sutter, and Sansome streets, San Francisco.

Joseph Lawrence, of Broderick, California, is using the Briggs' spreader cart system in the construction of the connecting link through the city of Roseville for the new state highway.

California Road & Street Improvement Co., of Fresno, which has taken extensive street paving contracts in Richmond, California, will use a Bacon baby tractor for hauling hot asphalt from the plant to the work.

City Street Improvement Co., of San Francisco, is using a train of 5-ton Troy reversible hauling trucks behind a C. L. Best gas tractor for hauling bituminous rock from the mine in Santa Cruz county to the railroad.

Salt Lake County, Utah, has just purchased a 30-hp. Avery under-mounted steam tractor from Landes & Co., of Salt Lake City, and eight Troy reversible spreading wagons from William Ogden, Western traveling representative of the Troy Wagon Works, Troy, Ohio.

Busch-Sulzer Bros.-Diesel Engine Co., of St. Louis, reports the receipt of an order for six 600-hp. marine Diesel engines to be furnished to the Lake Torpedo Boat Co. for installation on three twin-screw submarine torpedo boats to be built for the U. S. Government.

Austin Western Road Machinery Co., 22 Fremont street, San Francisco, reports the installation of a 150-ton electrically operated crushing plant for the Napa state insane asylum. Four Austin street-sprinklers have been supplied to the Panama-Pacific International Exposition.

Victor R. Browning Co., Cleveland, Ohio, has established Western sales offices at 503 Market street, San Francisco, with branches in Vancouver, Seattle, Portland, Salt Lake City, and Los Angeles for their gasoline-driven locomotive cranes and revolving steam-shovels. J. W. Leeper is Western manager.

A. L. Young Machinery Co., of San Francisco and Los Angeles, reports the delivery of three Kelley-Springfield steam macadam road rollers to the county of Los Angeles. The same Company reports the delivery of a 5½-ft. gasoline Buckeye ditching machine to C. B. Vincent, general contractor, of Oakland.

Kern County Land Co. is using a large Austin reversible elevating grader drawn by a Holt tractor for building irrigation canals and laterals. This equipment elevates from either side and the excavated material is deposited by a 30-ft. carrier. Twenty-five hundred yards per day can be handled by this combination.

Pacific Cement Gun Co., of San Francisco, has completed lining more than 500,000 sq. ft. of concrete irrigation ditch for the East Contra Costa Irrigation Co. near Brentwood, California. The Company is also coating 259 ornamental reinforced concrete electroliers for the San Francisco municipal railway on Van Ness avenue.

Edward R. Bacon Co., of San Francisco, has reported the following recent sales of Foote mixers: No. 6-A gasoline-driven paving mixer to Mahoney Bros., of San Francisco, for the concrete base on the Van Ness municipal railway; Bates, Borland & Ayer, of San Francisco, for the Fort Mason tunnel on the route for the San Francisco Belt railway; No. 5-A gasoline-driven paving mixer for the concrete roads of the San Francisco Presidio, and No. 6-A to Lynn S. Atkinson for use on the state highway construction in Kern county. This latter order includes also an Ohio self-propelled distillate road roller and a full complement of Troy dump-wagons.

Catalogues Received

Expanded Metal Engineering Co., Park avenue and 40th street, New York. Steelcrete products.

Kindling Machinery Co., Milwaukee, Wisconsin. Illustrated catalog, 'The Kindling Squeegee and Sand Spreader.'

Harron, Rickard & McCone, 139 Townsend street, San Francisco. Koehring concrete mixer. Illustrated catalog.

Victor R. Browning Co., Cleveland, Ohio, San Francisco office, Hooker & Lent building. Illustrated catalog on steam-shovels.

Chicago Pneumatic Tool Co., Chicago and New York. San Francisco office, 71 First street. Illustrated pamphlet on the Chicago stoper.

Connersville Blower Co., Connersville, Indiana. Bulletin 10-A, 'Type H Positive Blower'; Bulletin 19, 'Connersville Valveless Magma Pump.'

California Corrugated Culvert Co., West Berkeley. Illustrated pamphlet on corrugated iron construction on the Sacramento Valley irrigation project.

Pierson, Roeding & Co., Rialto building, San Francisco. Illustrated catalog, third edition. Descriptive of Orangeburg conduit manufactured by the Fibre Conduit Co. of Orangeburg, New York.

Yuba Construction Co., 433 California street, San Francisco. Illustrated catalog of the Yuba ball-tread tractor, showing its various applications and giving specifications of the types and sizes manufactured.

C. F. Braun & Co., Hooker & Lent building, San Francisco. Bulietin No. 7, 'Feed Water Heaters, Closed Type'; Bulletin No. 8, 'Wainwright Service Water Heater'; Bulletin No. 10, 'Alberger Centrifugal Steam Plant Auxiliaries.'

Woodin & Little, 33 Fremont street, San Francisco. General catalog 36. Illustrated, showing the full line of pumps of all types, supplies, gas-engines, together with complete price lists covering all of the machinery and supplies handled by this Company.

Hill, Hubbell & Co., Fife building, San Francisco. Bitumastic solution and enamel manufactured by the American Bitumastic Enamels Co. Illustrated catalog showing various applications of bitumastic enamel as a non-corrosive covering and water-proof compound.

Association of American Portland Cement Manufacturers, Philadelphia, Pennsylvania. Illustrated book dealing with factories and warehouses of concrete. Much valuable cost data are given as well as many instances of typical installations and types of construction.

General Electric Co., Schenectady, New York. Bulletin 46201, Single-phase Watthour meter, type I-14; Bulletins 43400, 43401, and 43402, Modern lighting in woodworking plants, the clothing industry, machine-shops, and metal-working plants; Bulletin 41302, Polyphase induction motors; Bulletin 48010, Electricity in the shoe and leather industry.

Harron, Rickard & McCone, San Francisco. Illustrated catalog of the American Hoist & Derrick Co. of St. Paul, Minnesota. This is a new edition and gives an excellent idea of the remarkable extent of the development made by this Company in the design and manufacture of material handling apparatus and appliances of all kinds. The book is copiously illustrated and replete with information of great value to engineers and contractors.

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